



**CONTRACT No GTC 626/2014A**

**CONSTRUCTION OF MEGA RESERVOIR PRPSs  
(PACKAGE A - UMM BIRKA)**

**CONTRACT DOCUMENTS  
(VOLUME 3 OF 19)**



**CONSOLIDATED CONTRACTORS GROUP S.A.L. (OFFSHORE) (CCC) &  
TEYSEER CONTRACTING COMPANY W.L.L.  
JOINT VENTURE**

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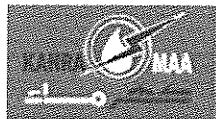
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**Qatar General Electricity & Water Corporation**  
**Tender No. GTC 626/2014**  
**Construction of Mega Reservoirs PRPSs**  
**(Package A, B, C, D & E)**

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### 3 ARCHITECTURAL WORKS

Unless otherwise stated in the Project Documentation, the Contractor shall comply with every requirement of the Qatar Construction Specification (QCS) that is relevant to the type of work forming any part of the Contract and shall adopt whichever permissible option or alternative is best suited to the needs of the work being undertaken.

This architectural specification is based on CSI/Masterspec. All references to Division and to Section numbers refer to this document. The Contractor is deemed to have his own copy of CSI/Masterspec.

All references to a specific manufacturer or supplier's product shall be construed as the stated product or equivalent approved.

#### 3.1 DIVISION 03 CONCRETE

##### 3.1.1 SECTION 03 45 00 - PRECAST ARCHITECTURAL CONCRETE

###### 3.1.1.1 GENERAL

###### 1. SUMMARY

A. This Section includes the following:

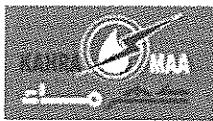
1. Architectural precast concrete cladding and load-bearing units.
2. Insulated, architectural precast concrete units.
3. Brick-faced, architectural precast concrete units.
4. Stone-faced, architectural precast concrete units.

B. Related Sections include the following:

1. Section 033000 "Cast-In-Place Concrete" for installing connection anchors in concrete.
2. Section 034900 "Glass-Fiber-Reinforced Concrete (GFRC)."
3. Section 047200 "Cast Stone Masonry" for wet or dry cast stone facings, trim, and accessories.
4. Section 042000 "Unit Masonry" for thin brick setting materials and installation after precast concrete panel production.
5. Section 051200 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
6. Section 055000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.
7. Section 071900 "Water Repellents" for water-repellent finish treatments.
8. Section 085113 "Aluminium Windows" for windows set into architectural precast concrete units.
9. Section 093000 "Tiling" for ceramic tile setting materials and installation.

###### 2. DEFINITION

- A. Design Reference Sample: Sample of approved architectural precast concrete colour, finish and texture, preapproved by Architect.



### **3. PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
- B. Loads: As indicated in Structural Engineer's Drawings and Specifications Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:
  1. Upward and downward movement of 25 mm.
- C. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 26 deg C.

### **4. ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
  1. Indicate separate face and backup mixture locations and thicknesses.
  2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
  3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
  4. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
  5. Include plans and elevations showing unit location and sequence of erection for special conditions.
  6. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
  7. Indicate relationship of architectural precast concrete units to adjacent materials.
  8. Indicate locations and details of brick units, including corner units and special shapes, and joint treatment.
  9. Indicate locations and details of stone facings, anchors, and joint widths.

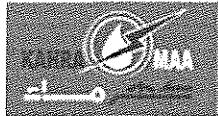


10. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
  11. Comprehensive engineering analysis certified by the qualified professional engineer responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.
- D. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, colour, and texture variations expected; approximately 300 by 300 by 50 mm.
1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, colour, and texture of backup concrete as well as facing concrete.
  2. Samples for each brick unit required, showing full range of colour and texture expected. Include Sample showing colour and texture of joint treatment.
    - a. Grout Samples for Verification: Showing colour and texture of joint treatment.
5. INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer, fabricator and testing agency.
  - B. Welding certificates.
  - C. Material Certificates: For the following items, signed by manufacturers:
    1. Cementitious materials.
    2. Reinforcing materials and prestressing tendons.
    3. Admixtures.
    4. Bearing pads.
    5. Structural-steel shapes and hollow structural sections.
    6. Brick units and accessories.
    7. Stone anchors.
  - D. Material Test Reports: For aggregates.
  - E. Source quality-control test reports.
  - F. Field quality-control test and special inspection reports.



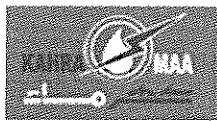
## 6. QUALITY ASSURANCE

- A. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load and S2 (Complex Structural Systems) for load-bearing members.
- B. Installer Qualifications: A precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project in same category as this Project before erection of precast concrete and who can produce an Erectors' Post-Audit Declaration.
- C. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
  - 1. Participates in PCI's plant certification program[ at time of bidding] and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units or participates in APA's "Plant Certification Program for Production of Architectural Precast Concrete Products" and is designated an APA-certified plant.
- D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- E. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- F. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- G. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- H. Calculated Fire-Test-Response Characteristics: Where indicated, provide architectural precast concrete units whose fire resistance has been calculated according to ACI 216.1/TMS 0216.1, "Standard Method for

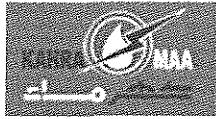


Determining Fire Resistance of Concrete and Masonry Construction Assemblies," PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," and is acceptable to authorities having jurisdiction.

- I. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of 2 sample panels approximately 1.5 sq/m in area for review by Engineer. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
  1. Locate panels where indicated or, if not indicated, as directed by Engineer.
  2. Damage part of an exposed-face surface for each finish, colour, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
  3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
  4. Demolish and remove sample panels when directed.
- J. Range Samples: After sample panel approval and before fabricating architectural precast concrete units, produce a minimum of 5 sets of samples, approximately 1.5 sq/m in area, representing anticipated range of each colour and texture on Project's units. Following range sample, maintain one set of samples at Project site and remaining sample sets at manufacturer's plant as colour and texture approval reference.
- K. Mock-ups: After sample panel and range sample approval but before production of architectural precast concrete units, construct full-sized mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mock-up as indicated on Drawings including aluminium framing, glass, sealants and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
  2. Approved mock-ups may become part of the completed Work if undamaged at time of Substantial Completion.
  3. Approval of mock-ups does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by Engineer in writing.



- L. Preconstruction Testing Mock-up: Provide a full-size mock-up of architectural precast concrete indicated on Drawings for preconstruction testing.
  - 1. Build preconstruction testing mock-up as indicated on Drawings including aluminium framing, glass, sealants, and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
  - 2. Build preconstruction testing mock-up at testing agency facility.
- M. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management And Coordination."
- 7. DELIVERY, STORAGE, AND HANDLING
  - A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
  - B. Support units during shipment on nonstaining shock-absorbing material.
  - C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
  - D. Place stored units so identification marks are clearly visible, and units can be inspected.
  - E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.
  - F. Lift and support units only at designated points shown on Shop Drawings.
- 8. SEQUENCING
  - A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.
- 9. PRODUCTS
  - 1. MANUFACTURERS
    - A. Fabricators: Subject to compliance with requirements, provide products by one of the following:  
United Precast Concrete; Architectural Panels
  - 2. MOLD MATERIALS
    - A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete



surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

- B. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

### **3. REINFORCING MATERIALS**

- A. Select one or more paragraphs in this Article to suit steel reinforcement requirements. Distinguish locations of each type of reinforcement here or on Drawings. If retaining Part 1 "Performance Requirements" Article, consider reviewing selections with fabricators.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- C. Retain paragraph below for reinforcement that is welded or if added ductility is sought.
- D. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- E. Retain galvanized reinforcing bars in paragraph below where corrosive environment or severe exposure conditions justify extra cost. Presence of chromate film on the surface of galvanized coating is usually visible as light yellow tint on the surface. ASTM B 201 describes a test method for determining presence of chromate coatings.
- F. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), ASTM A 706/A 706M, deformed bars, ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized, and chromate wash treated after fabrication and bending.
- G. Consider using epoxy coating where corrosive environment or severe exposure conditions justify extra cost. In first paragraph below, retain ASTM A 775/A 775M for a bendable epoxy coating; retain ASTM A 934/A 934M for a non-bendable epoxy coating.
- H. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), ASTM A 706/A 706M, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M epoxy coated.



- I. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), ASTM A 706/A 706M, deformed bars, assembled with clips.
- J. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from galvanized steel wire into flat sheets.
- K. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- L. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain, flat sheet, Type 1 bendable coating.
- M. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

#### **4. PRESTRESSING TENDONS**

- A. Prestressing Strand: ASTM A 416/A 416M, Grade 270 (Grade 1860), uncoated, 7-wire, low-relaxation strand.
- B. Coat unbonded post-tensioning strand with corrosion inhibitor passing ASTM D 1743 and sheath with polypropylene tendon sheathing. Include anchorage devices and coupler assemblies.

#### **5. CONCRETE MATERIALS**

- A. Delete materials in this Article that are not required; revise to suit Project.
- B. Portland Cement: ASTM C 150, Type I or Type III, grey, unless otherwise indicated.  
For surfaces exposed to view in finished structure, mix grey with white cement, of same type, brand, and mill source.
- C. Supplementary Cementitious Materials:
  1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3%.
  2. Metakaolin Admixture: ASTM C 618, Class N.
  3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
  4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- D. ASTM C 33 limits deleterious substances in coarse aggregate depending on climate severity and in-service location of concrete. Class 5S is the most restrictive designation for architectural concrete exposed to severe



weathering. PCI MNL 117 also establishes strict limits on deleterious substances for fine and coarse aggregates.

- E. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
  - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
    - a. Gradation: Uniformly graded.
  - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Engineer.
  - 3. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330, with absorption less than 11%.
- F. Delete first paragraph below if colouring admixture is not required. Add colour selection if known.
- G. Colouring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or coloured water-reducing admixtures, temperature stable, and nonfading.
- H. Water: Potable; free from deleterious material that may affect colour stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- I. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- J. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
  - 1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
  - 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.



6. High-Range, Water-Reducing and Retarding Admixture:  
ASTM C 494/C 494M, Type G.

7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

## 6. STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
- C. Carbon-Steel Plate: ASTM A 283/A 283M.
- D. Malleable Iron Castings: ASTM A 47/A 47M.
- E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).
- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65 (Grade 450).
- I. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
  1. ASTM A 307 defines the term "studs" to include stud stock and threaded rods.
- J. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563 (ASTM A 563M); and flat, unhardened steel washers, ASTM F 844.
- K. High-strength bolts are used for friction-type connections between steel members and are not recommended by PCI between steel and concrete because concrete creep and crushing of concrete during bolt tightening reduce effectiveness.
- L. High-Strength Bolts and Nuts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563 (ASTM A 563M); and hardened carbon-steel washers, ASTM F 436 (ASTM F 436M).
- M. Retain paragraph and subparagraphs below if galvanized finish is required. Revise locations of galvanized items if required. Field welding should generally not be permitted on galvanized elements unless galvanizing is removed or acceptable welding procedures are submitted.



Hot-dip galvanized finish provides greater corrosion resistance than electrodeposited zinc coating. Electrodeposition is usually limited to threaded fasteners.

- N. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M electrodeposition according to ASTM B 633, SC 3, Types 1 and 2.
- O. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25% or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
- P. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.
- Q. Retain first paragraph below if paint finish is required. Revise locations of priming if required. MPI 79 in first option provides some corrosion protection, while SSPC-Paint 25, without topcoating, provides minimal corrosion protection.
- R. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 SSPC-Paint 25 according to SSPC-PA 1.
- S. Welding Electrodes: Comply with AWS standards.

## 7. STAINLESS-STEEL CONNECTION MATERIALS

- A. Delete this Article if not required. Retain when resistance to staining merits extra cost in parking structures and other high-moisture or corrosive areas.
- B. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.
- C. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.
- D. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.
- E. Stainless-Steel-Headed Studs: ASTM A 276, with minimum mechanical properties of PCI MNL 117, Table 3.2.3.



## 8. BEARING PADS

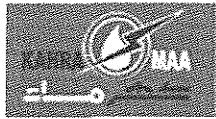
- A. Delete this Article if not applicable. Choice of bearing pad can usually be left to fabricator; coordinate selection with structural engineer if required.
- B. Provide one of the following bearing pads for architectural precast concrete units as recommended by precast fabricator for application.
- C. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength 2250 psi (15.5 MPa), ASTM D 412.
- D. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer hardness of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of 3000 psi (20.7 MPa) with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
- E. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; Type A durometer hardness of 80 to 100, ASTM D 2240; complying with AASHTO's "AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Division II, Section 18.10.2, or with MIL-C-882E.
- F. Frictionless Pads: Tetrafluoroethylene (Teflon), glass-fiber reinforced, bonded to stainless or mild-steel plate, of type required for in-service stress.
- G. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

## 9. ACCESSORIES

- A. Reglets: Specified in Section 076200 "Sheet Metal Flashing And Trim."
- B. Select paragraph above or first paragraph below if applicable. Coordinate reglet material with counterflashing materials and details.
- C. Reglets: PVC extrusions, Stainless steel, Type 302 or 304, Copper, felt or fiber filled, or with face opening of slots covered.
- D. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

## 10. GROUT MATERIALS

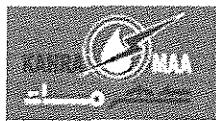
- A. Add other proprietary grout systems to suit Project. Show locations of each grout here or on Drawings if retaining more than one type.



- B. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Retain first paragraph below if non-shrink grout is required or if cement-grout shrinkage could cause structural deficiency. For critical installations, require manufacturer to provide field supervision.
- D. Non-metallic, Non-shrink Grout: Premixed, non-metallic, noncorrosive, non-staining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.
- E. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

#### **11. STONE MATERIALS AND ACCESSORIES**

- A. Stone facing for architectural precast concrete is specified in Section 044200 "Exterior Stone Cladding."
- B. Anchors are generally supplied by stone fabricator or, in some cases, by precaster. Specify supplier. Anchors may be toe in, toe out, or dowels.
- C. Anchors: Stainless steel, ASTM A 666, Type 304, of temper and diameter required to support loads without exceeding allowable design stresses.
- D. Grommets will usually be required if filling dowel holes with rigid epoxy.
- E. Fit each anchor leg with neoprene grommet collar of width at least twice the diameter and of length at least five times the diameter of anchor.
- F. Sealant Filler: ASTM C 920, low-modulus, multicomponent, non-sag urethane sealant complying with requirements in Section 079200 "Joint Sealants" and that is non-staining to stone substrate.
- G. Dowel hole filling is used to prevent water intrusion into stone and future discoloration at anchor locations. Retain paragraph above for flexible filler or first paragraph and subparagraph below for rigid filler.
- H. Epoxy Filler: ASTM C 881/C 881M, 100% solids, sand-filled nonshrinking, nonstaining of type, class, and grade to suit application.
- I. Elastomeric Anchor Sleeve: 13 mm long, Type A durometer hardness of 60, ASTM D 2240.



- J. Bond Breaker: Preformed, compressible, resilient, non-staining, nonwaxing, closed-cell polyethylene foam pad, non-absorbent to liquid and gas, 3.2 mm thick Polyethylene sheet, ASTM D 4397, 0.15 to 0.25 mm thick.

**12. INSULATED PANEL ACCESSORIES**

- A. Molded-Polystyrene Board Insulation: ASTM C 578, Type I, 0.90 lb/cu. ft. (15 kg/cu. m) VIII, 1.15 lb/cu. ft. (18 kg/cu. m) II, 1.35 lb/cu. ft. (22 kg/cu. m); square ship-lap edges;
- B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60 lb/cu. ft. (26 kg/cu. m) X, 1.30 lb/cu. ft. (21 kg/cu. m) VI, 1.80 lb/cu. ft. (29 kg/cu. m); square ship-lap edges;
- C. Polyisocyanurate Board Insulation: ASTM C 591, Type I, 1.8 lb/cu. ft. (29 kg/cu. m) IV, 2 lb/cu. ft. (32 kg/cu. m) II, 2.5 lb/cu. ft. (40 kg/cu. m) unfaced,
- D. Wythe Connectors: Glass-fiber and vinyl-ester polymer connectors Polypropylene pin connectors Stainless-steel pin connectors Bent galvanized reinforcing bars or galvanized welded wire trusses Cylindrical metal sleeve anchors manufactured to connect wythes of precast concrete panels.

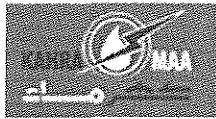
**13. CONCRETE MIXTURES**

- A. Prepare design mixtures for each type of precast concrete required.
- B. Revise subparagraph below if fly ash, silica fume, or metakaolin and silica fume are permitted. Revise percentages to suit Project.
- C. Limit use of fly ash and silica fume to 20% of portland cement by weight; limit metakaolin and silica fume to 10% of portland cement by weight.
- D. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- E. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- F. Architectural precast concrete units may be manufactured with a separate architectural face mixture and a structural backup mixture. Face and backup mixtures should have similar shrinkage and expansion coefficients. Similar water-cementitious materials ratios and cement-aggregate ratios are recommended by PCI to limit bowing or warping.



Retain first option in paragraph below if lightweight backup concrete mix is required; second option if normal-weight face and backup mixtures are required; third option if full-depth, normal-weight mixture is required; or fourth option if choice of normal-weight face and backup mixtures or full-depth mixtures is fabricator's option.

- G. Normal-Weight Concrete Mixtures: Proportion face mixtures, face and backup mixtures, full-depth mixture, face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  - 1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
- H. Water-cementitious materials ratio of 0.40 to 0.45 is usual for architectural precast concrete. Lower ratios may be possible with use of high-range water reducers. Maximum Water-Cementitious Materials Ratio: 0.45.
- I. Water absorption indicates susceptibility to weather staining. PCI states that limits in paragraph below are suitable for average exposures. Different parts of a single panel cannot be produced with different absorptions. Water Absorption: 6% by weight or 14% by volume, tested according to PCI MNL 117.
- J. Lightweight backup mixtures must be compatible with normal-weight face mixtures to minimize bowing or warping. Retain paragraph below if required or as an option if satisfactory durability and in-service performance are verified by fabricator. Coordinate with selection of normal-weight face mixture option above.
- K. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
  - 1. Compressive Strength (28 Days): 5000 psi (34.5 MPa).
- L. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu. ft. (1842 kg/cu. m), plus or minus 3 lb/cu. ft. (48 kg/cu. m), according to ASTM C 567.



- M. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- N. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

**14. MOLD FABRICATION**

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for pre-stressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and pre-stressing tendons by release agent.
- B. Delete form liners in subparagraph below unless needed to produce exposed surface finish.
- C. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- D. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
- E. Form joints are not permitted on faces exposed to view in the finished work.
- F. Select one option from subparagraph below; show details on Drawings or revise description to add dimensions. Sharp edges or corners of precast concrete units are vulnerable to chipping.
- G. Edge and Corner Treatment: Uniformly chamfered.

**15. STONE FACINGS**

- A. Accurately position stone facings to comply with requirements and in locations indicated on Shop Drawings. Install anchors, supports, and other attachments indicated or necessary to secure stone in place. Keep concrete reinforcement a minimum of 19 mm from the back surface of stone. Use continuous spacers to obtain uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.
- B. Stone to Precast Anchorages: Provide anchors in numbers, types and locations required to satisfy specified performance criteria, but not less

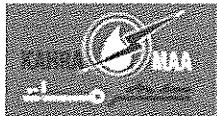


than 2 anchors per stone unit of less than 0.19 sq/m in area and 4 anchors per unit of less than 1.1 sq/m in area; for units larger than 1.1 sq/m in area, provide anchors spaced not more than 600 mm o.c. horizontally and vertically. Locate anchors a minimum of 150 mm from stone edge.

- C. Fill anchor holes with sealant filler and install anchors, epoxy filler and install anchors with elastomeric anchor sleeve at back surface of stone.
- D. Install polyethylene sheet to prevent bond between back of stone facing and concrete substrate and to ensure no passage of precast matrix to stone surface.

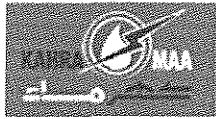
#### **16. FABRICATION**

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during pre-casting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
- B. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- C. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- D. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.
- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
- F. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
- G. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations.



Completely conceal support devices to prevent exposure on finished surfaces.

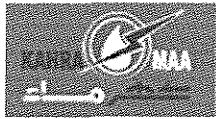
- H. Place reinforcement to maintain at least 19-mm minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
- I. Place reinforcing steel and pre-stressing strand to maintain at least 19-mm minimum concrete cover. Increase cover requirements for reinforcing steel to 38 mm when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
- J. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- K. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- L. Pre-stress tendons for architectural precast concrete units by either pre-tensioning or post-tensioning methods. Comply with PCI MNL 117.
- M. Delay detensioning or post-tensioning of precast, pre-stressed architectural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
- N. Detension pre-tensioned tendons either by gradually releasing tensioning jacks or by heat- cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- O. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
- P. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
- Q. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.



- R. Place face mixture to a minimum thickness after consolidation of the greater of 25 mm or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- S. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
- T. Place backup concrete mixture to ensure bond with face-mixture concrete.
- U. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
- V. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- W. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- X. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.
- Y. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

## 17. FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with the following product tolerances:
  1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:
    - a. 10 feet (3 m) or under, plus or minus 1/8 inch (3 mm).
    - b. 10 to 20 feet (3 to 6 m), plus 1/8 inch (3 mm), minus 3/16 inch (5 mm).
    - c. 20 to 40 feet (6 to 12 m), plus or minus 1/4 inch (6 mm).
    - d. Each additional 10 feet (3 m), plus or minus 1/16 inch (1.5 mm).



2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:
    - a. 10 feet (3 m) or under, plus or minus 1/4 inch (6 mm).
    - b. 10 to 20 feet (3 to 6 m), plus 1/4 inch (6 mm), minus 3/8 inch (10 mm).
    - c. 20 to 40 feet (6 to 12 m), plus or minus 3/8 inch (10 mm).
    - d. Each additional 10 feet (3 m), plus or minus 1/8 inch (3 mm).
  3. Total Thickness or Flange Thickness: Plus 1/4 inch (6 mm), minus 1/8 inch (3 mm).
  4. Rib Thickness: Plus or minus 1/8 inch (3 mm).
  5. Rib to Edge of Flange: Plus or minus 1/8 inch (3 mm).
  6. Distance between Ribs: Plus or minus 1/8 inch (3 mm).
  7. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches (3 mm per 1830 mm) or 1/2 inch (13 mm) total, whichever is greater.
  8. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch (6 mm).
  9. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch (19 mm).
  10. Dimensions of Haunches: Plus or minus 1/4 inch (6 mm).
  11. Haunch Bearing Surface Deviation from Specified Plane: Plus or minus 1/8 inch (3 mm).
  12. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or minus 1/4 inch (6 mm).
  13. Bowing: Plus or minus L/360, maximum 1 inch (25 mm).
  14. Local Smoothness: 1/4 inch per 10 feet (6 mm per 3 m).
  15. Warping: 1/16 inch per 12 inches (1.5 mm per 300 mm) of distance from nearest adjacent corner.
  16. Tipping and Flushness of Plates: Plus or minus 1/4 inch (6 mm).
  17. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch (3 mm).
- B. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
1. Weld Plates: Plus or minus 1 inch (25 mm).
  2. Inserts: Plus or minus 1/2 inch (13 mm).



3. Handling Devices: Plus or minus 3 inches (75 mm).
4. Reinforcing Steel and Welded Wire Fabric: Plus or minus 1/4 inch (6 mm) where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch (13 mm).
5. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch (13 mm) of plan dimensions.
6. Tendons: Plus or minus 1/4 inch (6 mm), vertical; plus or minus 1 inch (25 mm), horizontal.
7. Location of Rustication Joints: Plus or minus 1/8 inch (3 mm).
8. Location of Opening within Panel: Plus or minus 1/4 inch (6 mm).
9. Location of Flashing Reglets: Plus or minus 1/4 inch (6 mm).
10. Location of Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch (3 mm).
11. Reglets for Glazing Gaskets: Plus or minus 1/8 inch (3 mm).
12. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch (13 mm).
13. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch (6 mm).
14. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch (6 mm) maximum over the full dimension of unit.
15. Position of Sleeve: Plus or minus 1/2 inch (13 mm).
16. Location of Window Washer Track or Buttons: Plus or minus 1/8 inch (3 mm).

C. Stone Veneer-Faced Architectural Precast Concrete Units:

1. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated: Plus or minus 1/4 inch (6 mm).
2. Variation in Joint Width: 1/8 inch in 36 inches (3 mm in 900 mm) or a quarter of nominal joint width, whichever is less.
3. Revise or delete subparagraph below for natural-cleft, thermal, and similar finishes.
4. Variation in Plane between Adjacent Stone Units (Lipping): 1/16 inch (1.5 mm) difference between planes of adjacent units.

1.1. FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample, sample panels, mock-ups and as follows:



1. Select type of finish from subparagraphs below if needed. If more than one finish is required, add locations to finish descriptions or indicate on Drawings. Add more-detailed descriptions of finishes outlined below if greater definition, such as light, medium, or deep, is required,. See PCI MNL 117 for more information on finishes. An as-cast finish generally results in a mottled surface or non-uniform finish.
    2. As-Cast Surface Finish: Provide surfaces free of pockets, sand streaks, and honeycombs.
    3. Textured-Surface Finish: Impart by form liners or inserts to provide surfaces free of pockets, streaks, and honeycombs, with uniform colour and texture.
    4. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.
    5. Exposed-Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
    6. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
    7. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attack.
    8. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
    9. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
    10. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.
  - B. Finish exposed top, bottom and back surfaces of architectural precast concrete units to match face-surface finish.
  - C. Retain paragraph above or below if applicable. Revise below to float finish or light-broom finish if smooth, steel-trowel finish is unnecessary.
  - D. Finish exposed top, bottom and back surfaces of architectural precast concrete units by smooth, steel-trowel finish.
  - E. Revise finish in paragraph below to light-broom, stippled, or as-cast finish if float finish is unnecessary, or upgrade to smooth, steel-trowel finish.
  - F. Finish unexposed surfaces of architectural precast concrete units by float finish.
- ## 1.2. SOURCE QUALITY CONTROL
- A. Retain paragraph below if establishing a minimum standard of plant testing and inspecting. PCI MNL 117 mandates source testing requirements and a plant "Quality Systems Manual." PCI certification also ensures periodic auditing of plants for compliance with requirements in PCI MNL 117.
  - B. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6,



"Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Pre-stressed Concrete Institute Member Plants."

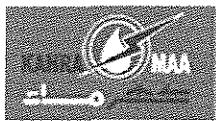
- C. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength.
- D. Review testing and acceptance criteria with structural engineer. In first paragraph and subparagraphs below, add criteria for load tests if required.
- E. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
  - 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
  - 2. Cores will be tested in an air-dry condition.
  - 3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85% of 28-day design compressive strength and no single core is less than 75% of 28-day design compressive strength.
  - 4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
    - a. Project identification name and number.
    - b. Date when tests were performed.
    - c. Name of precast concrete fabricator.
    - d. Name of concrete testing agency.
    - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- F. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

### **3.1.1.3 PART 3 – EXECUTION**

#### **1.1. EXAMINATION**

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

#### **1.2. INSTALLATION**



- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
  - B. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch (19 mm).
  - C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed. Do not permit connections to disrupt continuity of roof flashing.
  - D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
    1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide non-combustible shields as required.
    2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
    3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- (0.1-mm-) thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
    4. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and re-prime damaged painted surfaces.
    5. Remove, re-weld, or repair incomplete and defective welds.
  - E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
    1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25% of bolts at random by calibrated torque wrench.
  - F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
- 1.3. ERECTION TOLERANCES**
- A. Erect architectural precast concrete units level, plumb, square, and true, without exceeding the following noncumulative erection tolerances:
    1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch (13 mm).
    2. Plan Location from Centreline of Steel: Plus or minus 1/2 inch (13 mm).



3. Top Elevation from Nominal Top Elevation: As follows:
    - a. Exposed Individual Panel: Plus or minus 1/4 inch (6 mm).
    - b. Non-Exposed Individual Panel: Plus or minus 1/2 inch (13 mm).
    - c. Exposed Panel Relative to Adjacent Panel: 1/4 inch (6 mm).
    - d. Non-Exposed Panel Relative to Adjacent Panel: 1/2 inch (13 mm).
  4. Support Elevation from Nominal Support Elevation: As follows:
    - a. Maximum Low: 1/2 inch (13 mm).
    - b. Maximum High: 1/4 inch (6 mm).
  5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet (30 m): 1 inch (25 mm).
  6. Plumb in Any 10 Feet (3 m) of Element Height: 1/4 inch (6 mm).
  7. Maximum Jog in Alignment of Matching Edges: 1/4 inch (6 mm).
  8. Joint Width (Governs over Joint Taper): Plus or minus 1/4 inch (6 mm).
  9. Maximum Joint Taper: 3/8 inch (10 mm).
  10. Joint Taper in 10 Feet (3 m): 1/4 inch (6 mm).
  11. Maximum Jog in Alignment of Matching Faces: 1/4 inch (6 mm).
  12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch (6 mm).
  13. Opening Height between Spandrels: Plus or minus 1/4 inch (6 mm).
- 1.4. **FIELD QUALITY CONTROL**
- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections and prepare reports:
    1. Erection of precast concrete members.
  - B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
  - C. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
  - D. Testing agency will report test results promptly and in writing to Contractor and Engineer.
  - E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
  - F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 1.5. **REPAIRS**
- A. Blemishes occurring after delivery are normally repaired before final joint sealing and cleaning as weather permits.
  - B. Repair architectural precast concrete units if permitted by Engineer. The Engineer reserves the right to reject repaired units that do not comply with requirements.
  - C. Precast concrete manufacturer should develop appropriate repair mixtures and techniques during production sample approval process.



- D. Mix patching materials and repair units so cured patches blend with colour, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).
  - E. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
  - F. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
  - G. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.
- 1.6. **CLEANING**
- A. Clean surfaces of precast concrete units exposed to view.
  - B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
  - C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
    - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
    - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

### **3.1.2 SECTION 03 52 00 - LIGHTWEIGHT INSULATING CONCRETE**

#### **3.1.2.1 PART 1 – GENERAL**

##### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2. SUMMARY**

- A. Section includes cast-in-place perlite aggregate, vermiculite aggregate, cellular lightweight insulating concrete.
- B. Related Sections:

- 1. Civil and Structural Specifications "Cast-in-Place Concrete" for requirements for normal-weight and structural lightweight concrete, including formwork, reinforcement, and concrete materials and mixes.

##### **1.3. ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include mixing and application instructions for each type of lightweight insulating concrete.



- B. Shop Drawings: Include plans, sections, and details showing roof slopes, lightweight insulating concrete thicknesses, embedded insulation board, roof penetrations, roof perimeter terminations and curbs, control and expansion joints, and roof drains.

- C. Design Mixtures: For each lightweight insulating concrete mix.

#### **1.4. INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer and testing agency.

- B. Product Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Foaming agents.
3. Admixtures.
4. Moulded-polystyrene insulation board.

- C. Material Test Reports: For lightweight aggregates, from a qualified testing agency, indicating compliance with requirements.

- D. Field quality-control test reports.

#### **1.5. QUALITY ASSURANCE**

- A. Installer Qualifications: An Installer who employs and retains, throughout the project, supervisors who are trained and approved by manufacturer.

1. A firm that has been evaluated by UL and found to comply with requirements of the National Roof Deck Contractors Association Lightweight Insulating Concrete Roof Deck Contractors (LWIC) Accreditation Program.

- B. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

- C. Fire-Resistance Ratings: Where indicated, provide lightweight insulating concrete identical to those of assemblies tested for fire resistance per ASTME 119 by a qualified testing agency.

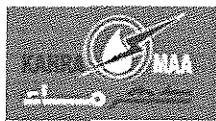
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

- D. FM Approvals Listing: Provide lightweight insulating concrete evaluated by FM Approvals as part of a roof assembly and listed in FM Approvals' "RoofNav" for Class 1 or non-combustible construction, as applicable.

- E. Provide vermiculite aggregates containing no detectable asbestos as determined by method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, and "Polarized Light Microscopy."

- F. Pre-installation Conference: Conduct conference at Project site.

#### **1.6. DELIVERY, STORAGE, AND HANDLING**



- A. Deliver materials in manufacturer's original undamaged packages or acceptable bulk containers.
- B. Store packaged materials to protect them from elements or physical damage.
- C. Do not use cement that shows indications of moisture damage, caking, or other deterioration.

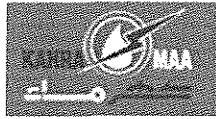
#### **1.7. PROJECT CONDITIONS**

- A. Do not place lightweight insulating concrete unless ambient temperature is at least 40 deg F (4.4 deg C) and rising.
  - 1. When air temperature has fallen or is expected to fall below 40 deg F (4.4 deg C), heat water to a maximum 120 deg F (49 deg C) before mixing so lightweight insulating concrete, at point of placement, reaches a temperature of 50 deg F (10 deg C) minimum and 80 deg F (27 deg C) maximum.
- B. Do not place lightweight insulating concrete during rain or snow or on surfaces covered with standing water, snow, or ice.

#### **3.1.2.2 PART 2 - PRODUCTS**

##### **1.1. MATERIALS**

- A. Cementitious Material: Portland cement, ASTM C 150, Type I, Type II, Type I/II, Type III. Supplement with fly ash, ASTM C 618, Class C or F.
- B. Lightweight Mineral Aggregate: ASTM C 332, Group I, vermiculite, perlite.
- C. Foaming Agent: ASTM C 869.
- D. Water: Clean, potable.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Joint Filler: ASTM C 612, Class 2, glass-fiber type; compressing to one-half thickness under a load of 25 psi (172 kPa).
- G. Steel Wire Mesh: Cold-drawn steel wire, galvanized, 0.041-inch (1.04-mm) diameter, woven into 2-inch (50-mm) hexagonal mesh, and reinforced with a longitudinal 0.062-inch- (1.57-mm-) diameter wire spaced 3 inches (75 mm) apart.
  - 1. Products / Manufacturer
    - a. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
    - b. Substitutions: See Section 016000 - Product Requirements.
- H. Galvanized Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, 2 by 2 inches (50 by 50 mm), W0.5 by W0.5, fabricated from galvanized steel wire into flat sheets.
- I. Moulded-Polystyrene Insulation Board: ASTM C 578, Type I, 0.90-lb/cu. ft. (14.4-kg/cu. m) minimum density.



1. Provide units with manufacturer's standard keying slots of approximately 3% of board's gross surface area.

#### **1.2. DESIGN MIXTURES**

- A. Prepare design mixtures for each type and strength of lightweight insulating concrete by laboratory trial batch method or by field-test data method. For trial batch method, use a qualified independent testing agency for preparing and reporting proposed mixture designs.

1. Limit use of fly ash to not exceed 25% of portland cement by weight.

- B. Limit water-soluble chloride ions to the maximum percentage by weight of cement or cementitious material permitted by ACI 301 (ACI 301M).

#### **1.3. AGGREGATE LIGHTWEIGHT INSULATING CONCRETE**

- A. Produce lightweight insulating concrete using the minimum amount of water necessary to produce a workable mix.

1. Do not exceed maximum air content recommended by aggregate manufacturer.

- B. Perlite Aggregate Mix: Lightweight insulating concrete produced from cementitious materials, water, air-entraining admixture, and perlite mineral aggregates.

- 1. Product / Manufacturer**

- a. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.

- b. Substitutions: See Section 016000 - Product Requirements.

2. As-Cast Unit Weight: 38 to 44 lb/cu. ft. (610 to 705 kg/cu. m) at point of placement, when tested according to ASTM C 138/C 138M.

3. Oven-Dry Unit Weight: 24 to 30 lb/cu. ft. (385 to 480 kg/cu. m), when tested according to ASTM C 495.

4. Compressive Strength: Minimum 125 psi (860 kPa), when tested according to ASTM C 495.

5. Cement-to-Aggregate Ratio, by Volume: [1:6].

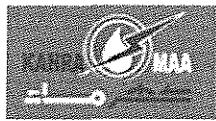
- C. Vermiculite Aggregate Mix: Lightweight insulating concrete produced from cementitious materials, water, air-entraining admixture, and vermiculite mineral aggregates.

- 1. Product / Manufacturer:**

- a. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.

- b. Substitutions: See Section 016000 - Product Requirements.

2. As-Cast Unit Weight: 45 to 49 lb/cu. ft. (720 to 785 kg/cu. m) at point of placement, when tested according to ASTM C 138/C 138M.



3. Oven-Dry Unit Weight: 23 to 26 lb/cu. ft. (370 to 416 kg/cu. m), when tested according to ASTM C 495.
  4. Compressive Strength: Minimum 140 psi (965 kPa), when tested according to ASTM C 495.
  5. Cement-to-Aggregate Ratio, by Volume: 1:6.
  6. As-Cast Unit Weight: 44 to 60 lb/cu. ft. (705 to 960 kg/cu. m) at point of placement, when tested according to ASTM C 138/C 138M.
  7. Oven-Dry Unit Weight: 22 to 28 lb/cu. ft. (352 to 450 kg/cu. m), when tested according to ASTM C 495.
  8. Compressive Strength: Minimum 125 psi (860 kPa), when tested according to ASTM C 495.
  9. Cement-to-Aggregate Ratio, by Volume: 1:6.
  10. As-Cast Unit Weight: 60 to 68 lb/cu. ft. (960 to 1090 kg/cu. m) at point of placement, when tested according to ASTM C 138/C 138M.
  11. Oven-Dry Unit Weight: 34 to 42 lb/cu. ft. (545 to 673 kg/cu. m), when tested according to ASTM C 495.
  12. Compressive Strength: Minimum 300 psi (2070 kPa), when tested according to ASTM C 495.
  13. Cement-to-Aggregate Ratio, by Volume: 1:3.5.
- 1.4. CELLULAR LIGHTWEIGHT INSULATING CONCRETE
- A. Produce cellular lightweight insulating concrete with the following minimum physical properties using cementitious materials, air-producing liquid-foaming agents, and the minimum amount of water necessary to produce a workable mix.
    1. Product / Manufacturer:
      - a. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
      - b. Substitutions: See Section 016000 - Product Requirements.
    2. As-Cast Unit Weight: 34 to 42 lb/cu. ft. (545 to 673 kg/cu. m) at point of placement, when tested according to ASTM C 138/C 138M.
    3. Oven-Dry Unit Weight: 26 to 32 lb/cu. ft. (416 to 513 kg/cu. m), when tested according to ASTM C 495.
    4. Compressive Strength: Minimum 190 psi (1310 kPa), when tested according to ASTM C 495.
    5. As-Cast Unit Weight: 34 to 42 lb/cu. ft. (545 to 673 kg/cu. m) at point of placement, when tested according to ASTM C 138/C 138M.
    6. Oven-Dry Unit Weight: 28 to 32 lb/cu. ft. (450 to 513 kg/cu. m), when tested according to ASTM C 495.



7. Compressive Strength: Minimum 200 psi (1380 kPa), when tested according to ASTM C 495.
8. As-Cast Unit Weight: 38 to 48 lb/cu. ft. (610 to 770 kg/cu. m) at point of placement, when tested according to ASTM C 138/C 138M.
9. Oven-Dry Unit Weight: 30 to 36 lb/cu. ft. (480 to 577 kg/cu. m), when tested according to ASTM C 495.
10. 10. Compressive Strength: Minimum 200 psi (1380 kPa), when tested according to ASTM C 495.

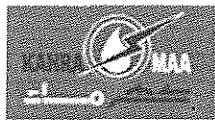
### **3.1.2.3 PART 3 - EXECUTION**

#### **1.1. PREPARATION**

- A. Control Joints: Install control joints at perimeter of roof deck and at junctures with vertical surfaces, including curbs, walls, and vents, for full depth of lightweight insulating concrete. Fill control joints with joint filler.
  1. Provide 1-inch- (25-mm-) wide control joints for roof dimensions up to 100 feet (30 m) in length; 1-1/2-inch- (38-mm-) wide control joints for roof dimensions exceeding 100 feet (30 m).
- B. Wire Mesh: Place steel wire mesh with longest dimension perpendicular to steel deck ribs. Cut mesh to fit around roof openings and projections. Terminate mesh at control joints. Lap sides and ends of mesh at least 6 inches (150 mm).
- C. Welded Wire Reinforcement: Place steel welded wire reinforcement with longest dimension perpendicular to steel deck ribs. Cut reinforcement to fit around roof openings and projections. Terminate reinforcement at control joints. Lap sides and ends of reinforcement at least 6 inches (150 mm).

#### **1.2. MIXING AND PLACING**

- A. Mix and place lightweight insulating concrete according to manufacturer's written instructions, using equipment and procedures to avoid segregation of mixture and loss of air content.
- B. Install insulation board according to lightweight insulating concrete manufacturer's written instructions. Place insulation board in wet, lightweight insulating concrete slurry poured a minimum of 1/8 inch (3 mm) over the structural substrate. Ensure full contact of insulation board with slurry. Stagger joints and tightly butt insulation boards.
  1. Install insulation board in a stair-step configuration with a maximum step-down of 1 inch (25 mm).
- C. Deposit and screed lightweight insulating concrete in a continuous operation until an entire panel or section of roof area is completed. Do not vibrate or work mix except for screeding or floating. Place to depths and slopes indicated.



- D. Finish top surface smooth, free of ridges and depressions, and maintain surface in condition to receive subsequent roofing system.
- E. Begin curing operations immediately after placement and air cure for not less than three days, according to manufacturer's written instructions.
- F. If ambient temperature falls below 32 deg F (0 deg C), protect lightweight insulating concrete from freezing and maintain temperature recommended by manufacturer for 72 hours after placement.

#### **1.3. FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform field tests and inspections, and prepare test reports.
- B. Testing of samples of lightweight insulating concrete obtained according to ASTM C 172, except as modified by ASTM C 495, shall be performed according to the following requirements:
  1. Determine as-cast unit weight during each hour of placement, according to ASTM C 138/C 138M.
  2. Determine oven-dry unit weight and compressive strength according to ASTM C 495. Make a set of at least six moulds for each day's placement, but not less than one set of moulds for each 5000 sq. ft. (465 sq. m of roof area).
  3. Perform additional tests when test results indicate that as-cast unit weight, oven-dry unit weight, compressive strength, or other requirements have not been met.
    - a. Retest cast-in-place lightweight insulating concrete for oven-dry unit weight and compressive strength.

#### **1.4. DEFECTIVE WORK**

- A. Refinish, or remove and replace, lightweight insulating concrete if surfaces are excessively scaled or too rough to receive roofing according to roofing membrane manufacturer's written instructions.
- B. Remove and replace lightweight insulating concrete that fails to comply with requirements.

### **3.1.3 SECTION 03 54 16 – SELF LEVELLING UNDERLayment**

#### **3.1.3.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

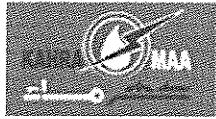
- A. Liquid-applied self-levelling floor underlayment.
  1. Use cementitious type at locations indicated on drawings or in relevant schedules and specification documents.

##### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:



1. Civil and Structural Specifications - Cast-in-Place Concrete.
  2. Section 096813 – Tile Carpet
- 1.3. REFERENCE STANDARDS**
- A. Standards
1. ASTM C 109/C 109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2007.
  2. ASTM C 348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars; 2002.
  3. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008.
- 3.1.3.2 PART 2 - PRODUCTS**
- 1.1. MATERIALS**
- A. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-levelling underlayment with the following properties:
1. Compressive Strength: Minimum 27.6 MPa after 28 days, tested per ASTM C 109/C 109M.
  2. Flexural Strength: Minimum 6.9 MPa after 28 days, tested per ASTM C 348.
  3. Density: Maximum 2002 kg/cu m.
  4. Final Set Time: 1-1/2 to 2 hours, maximum.
  5. Thickness: Feather edge to maximum 6 mm.
  6. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTME 84.
- B. Aggregate: Dry, well graded, washed silica aggregate, approximately 3 mm in size and acceptable to underlayment manufacturer.
- C. Reinforcement: Galvanized metal lath complying with recommendations of underlayment manufacturer for specific project circumstances.
- D. Water: Potable and not detrimental to underlayment mix materials.
- E. Primer: Manufacturer's recommended type.
- F. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.
- 1.2. MIXING**
- A. Site mix materials in accordance with manufacturer's instructions.



- B. Add aggregate for areas where thickness will exceed 12.5 mm. Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.
- C. Mix to self-leveling consistency without over-watering.

### 3.1.3.3 PART 3 – EXECUTION

#### 1.1. EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum bi-products, or other compounds detrimental to underlayment material bond to substrate.

#### 1.2. PREPARATION

- A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.
- B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- C. Vacuum clean surfaces.
- D. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- E. Close floor openings.

#### 1.3. APPLICATION

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Pump or pour material onto substrate. Do not re-temper or add water.
  - 1. Pump, move, and screed while the material is still highly flowable.
  - 2. Be careful not to create cold joints.
  - 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicate thickness, with top surface level to 1:1000.
- D. Place to thickness indicated.
- E. Where additional aggregate has been used in the mix, add a top layer of neat mix (without aggregate), if needed to level and smooth the surface.
- F. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

#### 1.4. CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.



**1.5. APPLICATION TOLERANCE**

- A. Top Surface: Level to 1:1000.

**1.6. FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field inspection and testing, as specified in Section 014000.

**1.7. PROTECTION**

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking. Do not permit traffic over unprotected floor underlayment surfaces.

**3.2 DIVISION 04 MASONRY**

**3.2.1 SECTION 04 06 53 – MORTAR AND MASONRY GROUT**

**3.2.1.1 PART 1- GENERAL**

**1.1. SECTION INCLUDES**

- A. Mortar for Masonry.  
B. Grout for Masonry.

**1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:

1. Section 042000 - Unit Masonry Assemblies

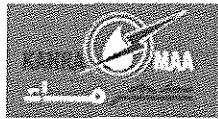
**1.3. REFERENCE STANDARDS**

- A. Standards

1. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International; 2005.
2. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; American Concrete Institute International; 2005.
3. ASTM C 91 - Standard Specification for Masonry Cement; 2005.
4. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2007.
5. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar; 2004.
6. ASTM C 150 - Standard Specification for Portland cement; 2007.
7. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006.
8. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2007a.
9. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout; 2007.



10. ASTM C 476 - Standard Specification for Grout for Masonry; 2007.
  11. ASTM C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2007a.
  12. ASTM C 1019 - Standard Test Method for Sampling and Testing Grout; 2008.
  13. BS 12 -1996, Specification for Portland Cement.
  14. BS 890 -1995, Specification for Building Lime.
  15. BS 1014 -1975, Specifications for Pigments for Portland Cement and Portland Cement Products.
  16. BS 1199 and 1200 -1976, Specifications for building sands from natural sources.
  17. BS 4887: Mortar admixtures, Part 1-1986: Specification for air entraining (Plasticizing) admixtures
  18. BS 5224 -1995, Specification for Masonry Cement
- 1.4. SUBMITTALS
- A. See Section 013000 - Administrative Requirements, for submittal procedures.
  - B. Product Data. Include design mix and indicate whether the Proportion or Property specification of ASTM C 270 is to be used. Also include required environmental conditions and admixture limitations.
  - C. Samples. Submit two samples of mortar, illustrating mortar colour and colour range.
  - D. Reports. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C 270 and test and evaluation reports per ASTM C 780.
  - E. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C 476 and test and evaluation reports to requirements of ASTM C 1019.
  - F. Manufacturer's Instructions. Submit packaged dry mortar manufacturer's installation instructions.
- 1.5. QUALITY ASSURANCE
- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.
- 1.6. DELIVERY, STORAGE AND HANDLING
- A. Maintain packaged materials clean, dry, and protected against dampness and foreign matter and damage by excessively high temperatures.
  - B. Handle and store cementitious materials protected against moisture.
- 1.7. FIELD CONDITIONS



- A. Cold and Hot Weather Requirements. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.
  - 1. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site and cause no damage to the products specified in this Section or to the performance of these products in use.
- B. Follow recommendations of the supplier of the products.
- C. Environmental conditions shall include, but not be limited to, ambient temperature, humidity, moisture in the air and on the products and surfaces with which they are in contact, moisture content and temperature of the products and the materials with which they are in contact.

## PART 2 - PRODUCTS

### 1.1. MATERIALS

- A. Use materials to meet requirements of specified reference standards of either British Standards or The Institution or American Society for Testing and Materials. However, only materials that comply with standards of a single authority shall be combined in a mortar mix.
- B. Portland Cement for concrete unit masonry. BS 12 ordinary Portland cement or ASTM C 150 Type I - Normal colour.
- C. Hydrated Lime. BS 890 or ASTM C 207, Type S.

#### D. Aggregate.

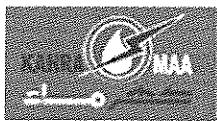
- 1. Clean, sharp sand, or BS 1199 and 1200, or ASTM C144.
- 2. Use only aggregates that have been verified as non-staining.
- 3. Mortar Aggregate Grading as given in table below;

B.S. Sieve No	Approx. Sieve Dimension	%of Aggregate Passing Sieve by Weight.
-----	3.0mm	95 - 100
7	2.4mm	80 - 100
14	1.2mm	60 - 100
25	0.6mm	30 - 100
52	0.3mm	5 - 65
100	0.15mm	0 - 15

- E. Pigments for Coloured Mortar. Iron or chromium oxides with demonstrated stability and colour fastness to meet requirements of BS 1014.
  - 1. Colours. As required to match Engineer colour samples.
  - 2. Acceptable product. Cemcol by BCR Building Chemical Research Co.
  - 3. Or equivalent.
- F. Water. Clean and potable, verify that water used contains no salts to cause efflorescence.



- G. Bonding Agent. Latex type.
- H. Non-Shrink Grout:
  - 1. Fosroc Conbextra HF, supplied by Al Gurg Fosroc LLC., P.O.Box 657, Dubai, UAE. Tel. 04 - 2039699, Fax. 04 - 2859649.
  - 2. Set Grout supplied by BASF Kanoo Gulf FZE, P.O.Box 61309, Jebel Ali Free Zone, Dubai. Tel. 04 - 8838 773, Fax. 04 - 8838 675.
  - 3. or equivalent as approved.
- I. Integral Mortar Waterproofer:
  - 1. Integral Liquid Waterproofer, by BCR
  - 2. Prolapin 031 by Al Gurg Fosroc LLC
  - 3. or equivalent as approved.
- 1.2. MORTAR MIXES
- A. Mortar for Unit Masonry. ASTM C 270, Property Specification.
  - 1. Engineered masonry. Type M, ASTM C270. Mix mortars with materials in following proportions;
    - a. 1 Portland cement.
    - b. 1/4 hydrated lime.
    - c. 3 loose damp sand, to produce mortar of 17.2 MPa compressive strength at 28 days.
    - d. Adjust sand proportions to allow for bulking of dry sand by moisture content.
  - 2. Exterior, load bearing masonry Type N, ASTM C270. Mix mortars with materials in following proportions;
    - a. 1 Portland cement.
    - b. 1/4 hydrated lime.
    - c. 6 loose damp sand, to produce mortar of 5.2 MPa compressive strength at 28 days.
    - d. Adjust sand proportions to allow for bulking of dry sand by moisture content.
- 1.3. MORTAR MIXING
- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Take precautions to prevent flash setting of mortar when mixed at high ambient temperatures.
- C. Do not mix mortar on concrete slabs.



- D. Incorporate plasticizing admixture with mortar in exterior walls. Mix mortar accordingly as specified for incorporation of plasticizer.
- E. Use grey mortar unless otherwise specified.
- F. Parging. Use type N mortar with integral waterproofing incorporated as recommended by integral waterproofing manufacturer.
- G. Pointing Mortar. Use in joints of 5mm and smaller.
  - 1. Incorporate aggregate to meet specified requirements but with not less than 95% passing a 1.18mm sieve opening.
  - 2. Mix as stiff as can be worked and pre-hydrate.
- H. Concrete Grout. For reinforced masonry and filled cells of concrete units.
  - 1. Mix one part Portland cement and three parts sand with water.
- I. Add mortar colour in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
  - 1. Limit quantity of mortar colour to following percentages of cement content by weight;
    - a. 15% of mineral oxides.
    - b. 3% for carbon black.
  - 2. Limit aggregate to white sand or ground limestone or marble if required to achieve required colour.

#### 1.4. GROUT MIXING

- A. Mix grout in accordance with ASTM C 94/C 94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C 476 for fine and coarse grout.
- C. Add admixtures in accordance with manufacturer's instructions, mix uniformly.

#### 1.5. PRECONSTRUCTION TESTING

- A. Mortar Mixes. Test mortars pre-batched by weight in accordance with ASTM C 780 recommendations for preconstruction testing.
  - 1. Test results will be used to establish optimum mortar proportions and establish quality control values for construction testing.
- B. Grout Mixes. Test grout batches in accordance with ASTM C 1019 procedures.
  - 1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

#### PART 3 - EXECUTION



### **1.1. PREPARATION**

- A. Protection. Provide waterproof protection over construction surfaces at mixing areas to prevent deposit on them of mortar and mortar materials.
- B. Apply bonding agent to existing concrete surfaces.

### **1.2. MORTAR TYPES**

- A. for laying masonry use mortar type;
  - 1. M ASTM C270, in masonry walls in contact with earth.
  - 2. S ASTM C270 coloured as selected, for exterior stone.
  - 3. N ASTM C270 unless otherwise specified.

### **1.3. INSTALLATION**

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 400 mm without consolidating grout by rodding.
- D. Do not displace reinforcement while placing grout.
- E. Remove excess mortar from grout spaces.

### **1.4. FIELD QUALITY CONTROL**

- A. Test and evaluate mortar in accordance with ASTM C 780 procedures.
- B. Test and evaluate grout in accordance with ASTM C 1019 procedures.

## **3.2.2 SECTION 04 20 00 - UNIT MASONRY ASSEMBLIES**

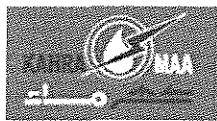
### **3.2.2.1 PART 1 - GENERAL**

#### **1.1. SECTION INCLUDES**

- A. Supply and installation of concrete unit masonry including, Hollow Concrete Blocks, Solid Concrete Blocks and other unit masonry items as indicated on drawings and as specified herein.
- B. Supply and installation of anchors, ties, reinforcement, flashing and other accessories as specified and required by the Works.
- C. Cooperation with personnel performing quality control inspection and testing.

#### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:
  - 1. Concrete Reinforcement – Civil & Structural Specifications.
  - 2. Section 040653 - Mortar and Masonry Grout.



3. Section 079000 - Joint Sealers.
4. Section 099000 – Paints & Coatings

#### **1.3. REFERENCE STANDARDS**

##### **A. Standards**

1. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International; 2005.
2. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; American Concrete Institute International; 2005.
3. ASTM A 82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
4. ASTM C 140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2007a.

#### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data. Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples. Submit to site samples of each shape and type of concrete block including 100mm, 150mm, 200mm thick, damp-proof flashing and lap cement, joint packing, joint reinforcement, anchors and anchor slots.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

#### **1.5. QUALITY ASSURANCE**

- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.
- B. Construction Requirements.
  1. Before commencing masonry work, verify that site conditions will allow construction of masonry within required limitations for wall heights, wall thicknesses, openings, bond, anchorage, lateral support and compressive strengths of masonry units and mortars.
  2. Construct masonry fire rated assemblies to meet requirements of local Civil Defense Authority.
- C. Source Quality Control.
  1. Refer to Section 014000 for quality control requirements.
  2. Verify that masonry units and other masonry products specified in this Section meet specified requirements.



3. Test five masonry units selected at random from each production run to verify that they meet specified requirements.
4. Immediately following each test, submit a copy of reports to Engineer.

**1.6. MOCK-UP**

- A. Construct one of each type of masonry wall as a mock-up panel sized 2.4m long by 1.8m high to show colour range, acceptable level of smoothness, texture, bond, jointing and unit cutting to provide mock-up as specified in Section 014000.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.
- D. Include in mock-up; parging, damp-proof flushing, specified masonry units and accessories as specified in this section.
- E. Construct a sample wall for each type of masonry specified which is exposed to view including parged wall, painted wall and wall faced with stone.

**1.7. PRE-INSTALLATION MEETING**

- A. Convene one week before starting work of this section.

**1.8. DELIVERY, STORAGE and HANDLING**

- A. Deliver, handle and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Ensure that moisture content of concrete masonry units is maintained within specified limits from time of shipment from plant to time of installation.
- C. Cover masonry unit stockpiles while stored to prevent exposure to weather.
- D. Handle and store masonry units to prevent soiling and chipping.
- E. Deliver products to the place on site as directed and to meet installation schedule.
- F. Do not dump block upon delivery, but carefully unload and stack by hand.

**1.9. ENVIRONMENTAL REQUIREMENTS**

- A. Hot Weather Requirements. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.
- B. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site and cause no damage to the products specified in this Section or to the performance of these products in use.
- C. Follow recommendations of the supplier of the products.



- D. Environmental conditions shall include, but shall not be limited to, ambient temperature; humidity; moisture in the air and on the products and surfaces with which they are in contact; moisture content and temperature of the products and the materials with which they are in contact.

## PART 2 - PRODUCTS

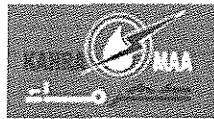
### 1.1. CONCRETE MASONRY UNITS

#### A. Concrete masonry units

1. Manufacture concrete masonry units with stone aggregate to meet specified requirements of BS 6073, except where otherwise specified herein and as approved by Engineer.
2. Blocks of all thickness shall match approved samples.
3. Smooth faced units with no visible checks, cracks, spalls or other defects shall be used for un-plastered walls with paint finish only. For all plastered walls, standard faced units will be acceptable.
4. Hollow Units. Two cells with area of cells no greater than 40% of total cross sectional area.
5. Solid Units. Entirely solid or two cell units with area of cells no greater than 25% of total cross sectional area.
6. Size. Nominal 400mm long x 200 mm high x thickness indicated on Drawings.
7. Compressive Strength. Minimum 50kg/sq.cm when tested at 28 days.
8. Moist cure units a minimum of seven (7) days. Do not deliver units to site before 30 days have elapsed following production.
9. Include all special shapes required for complete masonry installation.

#### B. Insulated Cement Concrete Blocks

1. Blocks shall consist of dovetailed moulded Polystyrene core sandwiched between two layers of normal weight concrete. Block shall comply with BS 6073 and the characteristics shall be as follows:
  - a. Length: 400 mm.
  - b. Height: 200 mm.
  - c. Width: To match the thickness as indicated on the drawings.
  - d. Block Density: 1350 kg/cu.m.
  - e. Compressive Strength: Minimum 7.5 N/sq.mm (Average), Minimum 6.0 N/sq.mm (Individual)
2. Blocks shall be cast integrally with the dovetailed polystyrene insert in the mould.
3. Polystyrene insert used shall conform to the following:



- f. Density: 22 kg/cu.m. (Min)
- g. Thermal conductivity at 35 degree C and 60% R.H.: 0.037 W/(m.K) (max.)
- h. Type: moulded.

#### 1.2. MORTAR AND GROUT MATERIALS

- A. Mortar and grout: As specified in Section 040653.

#### 1.3. REINFORCEMENT AND ANCHORAGE

- A. Joint Reinforcement.

- 1. Manufacturer of welded cold drawn steel wire conforming to either BS 4482 or ASTM A82, with no cavity drips and in ladder or truss type conformation.
- 2. Provide deformed or knuckled longitudinal wires and plain cross wire of minimum 3.6mm diameter.
- 3. Ensure that welded junctions are no higher than 6mm and that welded junction develops at least 50% of the tensile strength of cross wires.
- 4. Provide maximum cross wire or truss panel point spacing of 400mm.
- 5. Provide prefabricated sections to maintain continuity of reinforcement at intersecting wall and external corners.
- 6. Hot dip-galvanize reinforcement after fabrication to meet specified requirements of BS EN ISO 1461.

- B. Reinforcing Steel.

- 1. For grouted reinforced masonry, to meet specified requirements Concrete Reinforcement – Civil & Structural Specifications.

- C. Dovetail Anchor and Anchor Slots.

- 1. 1.22mm thick formed epoxy coated steel dovetail slots for attachment to formwork; with 2.5mm thick epoxy coated hooked steel anchor fixings to fit dovetail slots snugly to suit conditions. Provide easily removable filler of dovetail slots to prevent entry of concrete.
- 2. Provide dovetail anchor slots discontinuously, 200mm long at location of each anchor.

#### 1.4. FLASHINGS

- A. Damp-proof Flashing.

- 1. To meet specified requirements of BS 6398, bituminous damp-proof course with lead-core and minimum weight of 4.9kg/sq.m.
- 2. Manufacturer



- a. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
- b. Substitutions: See Section 016000 - Product Requirements.

**B. Damp-roofing Lap Cement:**

1. Bituminous lap cement supplied by flashing manufacturer.

**1.5. ACCESSORIES**

**A. Control Joints.**

1. Form control joints of synthetic rubber compound conforming to ASTM D 2000, 2AA-805, with minimum durometer hardness of 70 when tested in accordance with ASTM D 2240.
2. Acceptable control joints Manufacturer: Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in.

**B. Weep-holes.**

1. 12mm O.D. polyethylene or PVC tubing of length suitable to ensure drainage.

**C. Joint Packing at Walls.**

1. Preformed fire Separation Packing at tops of fire rated walls and partitions, semi-rigid mineral (rock-wool) board with minimum density of 48kg/cu.m, to provide 50 % compression when installed in voids and of composition approved by local Civil Defense Authority.
2. Manufacturer
  - a. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  - b. Substitutions: See Section 016000 - Product Requirements.

**3.2.2.3 PART 3 - EXECUTIONS**

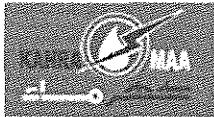
**1.1. EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location and ready for roughing into masonry work.

**1.2. PREPARATION**

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

**1.3. COURSING**



- A. Establish lines, levels and coursing indicated. Protect from displacement. Minimize cutting of joints.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

#### **1.4. PLACING AND BONDING**

##### **A. Laying Masonry.**

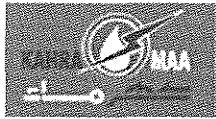
- 1. Construct masonry to meet specified requirements of jurisdictional authorities except that where requirements of this Section are more stringent, this Section shall govern.
- 2. Lay masonry as shown on Drawings, to course on 200mm modules (centre-to-centre of joints) and to minimize cutting of units.
- 3. Use only dry materials.
- 4. Ensure that concrete masonry units which have absorbed moisture at the site have dried sufficiently to meet moisture limits specified for units at time of delivery before they are incorporated in the work.
- 5. Lay masonry in running bond with vertical joints of alternate courses in line.
- 6. Align webs of concrete unit masonry vertically and with thick ends on top.

##### **B. Joints.**

- 1. Make joints of uniform thickness with vertical joints from course to course maintained plumb.
- 2. Provide full bed and head joints for solid units, for starting course, for pilasters, piers and columns and for shear walls.
- 3. Do not furrow bed joints.
- 4. Install metal lath in bed joints at bottom of cells which will be filled with mortar.
- 5. When laying is resumed on walls previously laid with mortar, either partially or totally set, remove loose units and mortar from top and adjoining surfaces. Remove mortar completely when masonry is removed and replaced with new.
- 6. Form tooled concave joints wherever exposed to view. When mortar has become "thumb-print" hard, tool joints and clean off burrs with trowel or burlap. Use a tool with a bearing surface of 550mm minimum length on horizontal joints to avoid uneven depressions.
- 7. Rake out joints of masonry exposed to view to provide caulking;
  - a. At juncture of interior and exterior walls with columns.
  - b. At interior with exterior walls.
  - c. Intersections of walls and partitions where joint reinforcement is installed.



- d. At caulked joints where typically indicated.
- 8. Cut joints off flush where tooled joints are not required.
- 9. Ensure that no mortar protrudes from joints on wall surfaces to which insulation will be applied.
- C. Stop off horizontal runs of walls by tracking back a half unit in each horizontal course. Do not tooth.
- D. Moisten concrete units on mortared faces as dictated by site conditions to prevent too rapid curing of mortar.
- E. Distribute masonry units of varying colours and textures to avoid spotty appearance over wall surfaces exposed to view. Do not use units which contrast too greatly with the overall range.
- F. Use chipped and blemished units only where concealed. Do not use defective or broken units. Do not lay concrete units with markedly smooth face that will appear slick where exposed to view, whether painted or not.
- G. Maintain bracing of walls and piers continuously during construction until structures provides support.
- H. Cope, cut and split concrete masonry units with power driven abrasive discs. Cut units wherever electrical outlets, grilles and pipes occur. Allow 3mm clearance around items which are incorporated in walls.
- I. Do not expose open cells, cores or frogs of masonry to view.
- J. Flush surfaces smooth with mortar masonry against which flashing and damp-proof flashing rests to ensure that it is not punctured.
- K. Locate bearings and piers as indicated on Drawings. Provide solid masonry units at bearings. Grout under bearing plates installed on masonry with non-shrink grout. Remove shims after grout has cured and fill voids solidly with grout.
- L. Extend walls and partitions at top deck, slab or structural members as applicable, except where otherwise noted in the Contract Documents. Incorporate both lateral support and deflection space at termination of walls as required by this Section.
- M. Curing. Ensure that masonry is maintained moist while being installed and for at least 48hrs following joint finishing.
- N. Deflection Space.
  - 1. Incorporate a deflection space between tops of non-load-bearing walls and partitions and structure to prevent transference of structural loads to masonry.
  - 2. Fill deflection space with joint packing board compressed to 50% of original thickness to completely seal space.
  - 3. Coordinate laying of masonry with installation of lateral supports specified in this Section.



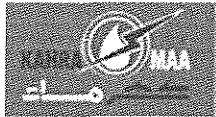
4. Ensure that lateral supports are located correctly.
- O. Penetrations of Masonry.
  1. Fill voids of masonry to within 19mm of structural members, pipes, ducts and conduits that penetrate masonry walls and portions, unless otherwise indicated.
  2. Build in sleeves as indicated.
- P. Construction of Insulated Concrete Block wall shall be conform to the following:
  1. Polystyrene strips of width equal to the thickness of the insulation used in the block and having a thickness equal to the mortar joint, shall be included in all horizontal and vertical mortar joints to provide continuity for the polystyrene thermal insulation layer.
  2. Galvanized mesh reinforcement 150 mm. wide, or equivalent, shall be embedded in mortar joints at every third course to ensure the overall stability of the wall.
  3. Galvanized column-masonry junction wall ties, 2.5 mm x 20 mm x 150 mm, shall be used.
  4. If the wall height is more than 3.5 m, galvanized beam-masonry wall ties of 2.5mm x 20mm x 75mm shall be fixed at 1.2 m c/c approximately.

#### **REINFORCEMENT AND ANCHORAGE**

- A. Joint Reinforcement.
  1. Install joint reinforcement in solid walls and partitions constructed of concrete masonry joints.
  2. Place reinforcement continuously in horizontal joints at 400mm on centre beginning with course 400mm above bearing, unless otherwise specified or indicated.
  3. Place reinforcement additionally in courses 200mm, 400mm and 810mm above and below openings and extending 600mm beyond jambs of openings.
  4. Where changes in wall thickness occur, extend reinforcement in lesser width, 450mm beyond changes of width.
  5. Lap reinforcement a minimum of 150mm at splices.
  6. Do not run reinforcement through control or expansion joints.
  7. Wherever walls and partitions intersect one another, or cross each other, continue reinforcement through. Do not carry reinforcement through intersections where lateral support anchors are installed or at intersections of walls and partitions with solid piers.
- B. Masonry Anchorage.
  1. Use dovetail anchors for slots at concrete construction.
  2. Bed anchors solidly in mortar joints.
  3. Ensure that dovetail anchor slots in concrete are located correctly.



- C. Lateral Support.
  - a. Lateral support clips
  - b. Where lateral support is provided by dowels as indicated on Drawings, pack cores solidly with mortar and embed dowels in the mortar.
  - c. Ensure that lateral supports are located correctly.
- 1.5. REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY
  - A. Deflection Space;
    - 1. Incorporate a deflection space between tops of non-load-bearing walls and partitions and structure to prevent transference of structural loads to masonry.
    - 2. Fill deflection space with joint packing board compressed to 50% of original thickness to completely seal space
- 1.6. MASONRY FLASHINGS
  - A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - B. Install damp-proof flashing as indicated on Drawings. Where indicated install weep-holes at lowest level of damp-proof course spaced 1200mm on centre and set to drain.
- 1.7. LINTELS
  - A. Reinforced block lintels.
    - 1. Reinforced block lintels, may be used as substitute for pre-cast lintels only on written approval of Engineer.
    - 2. Fabricate pre-cast concrete block lintels in accordance with shop drawings approved by Engineer.
    - 3. Set reinforcement bars as per shop drawings and fill void of block with concrete grout.
    - 4. Maintain normal vertical joint spacing and point joints with mortar.
    - 5. Allow lintels to cure before lifting and building into wall.
- 1.8. FIRE SEPARATIONS.
  - A. Construct fire separation wall tightly to construction at perimeter and without openings or voids.
  - B. Do not reduce the thickness of masonry fire separations to less than the thickness indicated for the required separation rating.
- 1.9. CONTROL JOINTS
  - A. Shrinkage Control Joints.



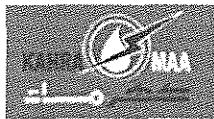
1. Incorporate vertical shrinkage control joints in walls of which concrete masonry units are a part.
2. Install control joints at junctions of walls and columns, at intersections of unit concrete masonry load-bearing walls and wherever indicated on Drawings and otherwise in walls with no openings, at a maximum spacing of 6m. Carry joints full height of walls.
3. Ensure complete vertical separation through walls incorporating control joints. Make control joints 9.5mm wide, rake back 19mm at junctures with concrete and leave joints free and clear for caulking.
4. Construct control joints of standard block and fill void between block with 20N/mm<sup>2</sup> concrete grout to form a continuous key full height of joint. Maintain separation between walls on each side of joint by installation of continuous building paper between concrete key and block on one side of joint.
5. Alternatively, construct control joints as indicated on drawings.

#### **1.10. BUILT-IN WORK**

- A. Verify that built-in items as specified in other Sections are available for building-in before laying of masonry commences. Cooperate in the setting and aligning of built-in items and provide for later installation of items which are installed by other Sections to avoid cutting, fitting and patching.
- B. Build masonry around pressed steel door frames supplied and set as specified in other Sections. Ensure that anchors are well secured and that frames are true and plumb. Completely fill frames with mortar as each course is laid. Maintain protective frame covering and ensure that no mortar is left on frame faces.

#### **1.11. TOLERANCES**

- A. Lay masonry to following tolerances.
  1. Walls, plumb within 6mm in 3000mm, 10mm in any storey or 6000mm and 13mm in 12000mm or greater.
  2. External corners, expansion joints and other conspicuous lines and levels, plumb within 6mm in any storey or bay or 6000mm and 13mm in 12000mm or greater.
  3. Level within 6mm in any bay or 6000mm maximum distance and 13mm in 12000mm or greater.
  4. Located from position shown and from related position of columns, walls and partitions, within 13mm in any bay or 6000mm maximum distance and 19mm in 12000mm or more.
  5. Opening sizes within 6mm of designated dimension
  6. Column and wall cross-section dimensions within minus 6mm and plus 13mm
  7. With joints to dimensions indicated ±3mm, but in no case greater than 13mm.



#### **1.12. CUTTING AND FITTING**

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

#### **1.13. FIELD QUALITY CONTROL**

- A. Inspect and report on mortar materials and on compressive strength of mortar samples as laying of masonry progresses. Provide six No 50mm cubes of mortar from samples taken randomly at the site for each test, as directed.
- B. Immediately following inspection and/or testing submit a copy of reports to Engineer.

#### **1.14. CLEANING**

- A. Point all holes in mortar joints except weep holes.
- B. Point all voids in concrete unit masonry faces.
- C. Cut out defective mortar joints to a minimum depth of 13mm and re-point.
- D. Clean concrete masonry units with brushes or as otherwise recommended by supplier to remove mortar and stains.
- E. Do not use wire brush for cleaning.
- F. Should specified cleaning methods be insufficient, proceed with other methods only with approval.
- G. Protect adjacent materials, construction and finished surfaces from damage while cleaning.
- H. Ensure that all efflorescence and mortar deposits are removed from surfaces to receive coating.
- I. Clean mock-up wall as directed well before cleaning of masonry is required. If methods are approved, follow same cleaning procedures for installed masonry.

#### **1.15. PROTECTION**

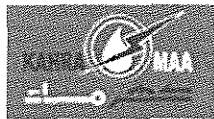
- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

### **3.2.3 SECTION 04 24 00 - AUTOCLAVED AERATED CONCRETE UNITS**

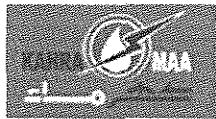
#### **3.2.3.1 PART 1 – GENERAL**

##### **1.1. SUMMARY**

- A. Section includes, but is not limited to: Fabrication, transportation, and erection of Autoclaved Aerated Concrete (AAC) units.
- B. Related sections:



1. Concrete Reinforcement, Cast-in-Place Concrete – Civil & Structural Specifications
  2. Section 040653: Masonry Grout.
  3. Section 078413: Penetration Firestopping.
  4. Section 079000: Joint Sealants.
- 1.2. REFERENCES
- A. Standards of the following as referenced:
1. American Concrete Institute (ACI).
  2. ASTM.
  3. The Masonry Society (TMS).
  4. Underwriters Laboratories, Inc. (UL).
- 1.3. DEFINITIONS
- A. Terms:
1. AAC unit: Autoclaved Aerated Concrete Unit.
  2. Bed joint: Horizontal mortar joint between two AAC units.
  3. Head joint: Vertical joint between two AAC units.
  4. Strength Class: Classification that defines the physical properties of the AAC, designated as AC2, AC4, or AC6.
- 1.4. SUBMITTALS
- A. Quality control submittals:
- a. Certificate from the AAC manufacturer indicating AAC product is manufactured in accordance with ASTM C 1386.
- 1.5. QUALITY ASSURANCE
- A. Furnish AAC units from single manufacturer.
- B. Mock-ups:
1. Lay 2.00m long by 1.20m high sample wall with AAC units. Orient wall as directed by the Engineer.
  2. The following items are to be approved:
    - a. Mortar joints.
    - b. Control joint complete with joint sealant.
    - c. Workmanship.



- d. Reinforcement, if required.
- e. Flashing.
- f. Exterior finishes.
- g. Interior finishes.
3. Prepare sample wall at least 14 days prior to beginning AAC unit work. Should wall be disapproved, prepare additional walls until approved by Engineer.
4. Maintain wall throughout work as standard of AAC unit work. Do not destroy wall until directed by Engineer.

#### **1.6. DELIVERY, STORAGE, AND HANDLING**

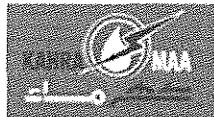
##### **A. Storage and protection:**

- a. Offload AAC units and store using pallets resting on ground. Placing AAC units in direct contact with earth is prohibited.
- b. Protect AAC units from oil and chemical staining.

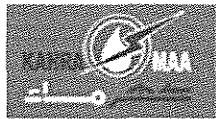
#### **1.7. PROJECT CONDITIONS**

##### **A. Cold and hot weather installation practices:**

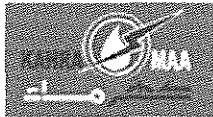
1. Cold weather precautions for AAC masonry work:
  - a. When temperature of AAC units is below 20°F, do not install.
  - b. Remove visible ice on AAC units prior to installation.
  - c. Heat mortar sand or mixing water to produce mortar temperatures between 40°F and 120°F at time of mixing. Maintain mortar temperature above freezing until placed.
  - d. Ambient temperature requirements:
    - 1) Between 25°F and 20°F: Use heat sources on both sides of AAC walls under construction. Install wind breaks when wind velocity is in excess of 15 mph.
    - 2) Below 20°F: Provide enclosure for AAC walls under construction. Use heat sources to maintain temperatures above 32°F within enclosures.
  - e. Daily mean temperature requirements:
    - 1) Between 40°F and 32°F: Protect completed AAC walls from rain or snow by covering with weather resistive membrane for a minimum of 24 hours after construction.
    - 2) Between 32°F and 25°F: Completely cover completed AAC walls with weather resistive membrane for a minimum of 24 hours after construction.
    - 3) Between 25°F and 20°F: Completely cover completed AAC walls with insulating blankets or equal protection for a minimum of 24 hours after construction.



- 5) Below 20°F: Maintain AAC wall construction above 32°F for 24 hours after completion by enclosure with supplementary heat, electric heating blankets, infrared heat lamps, or other acceptable methods outlined to the Engineer.
2. Hot weather precautions for AAC masonry work:
- a. When erected in ambient air temperature of 100°F or ambient air temperature of 90°F with wind velocity in excess of 8 mph, implement the following:
    - 1) Protect AAC wall construction from direct exposure to wind and sun.
    - 2) Spreading mortar beds more than 1.20m ahead of AAC units is prohibited.
    - 3) Setting AAC unit more than one minute after spreading mortar is prohibited.
- 1.8. SEQUENCING AND SCHEDULING
- A. Loading AAC unit walls or columns is prohibited prior to the following:
1. Uniform floor or roof loads: 12 hours, minimum.
  2. Concentrated loads: Three days, minimum.
- B. Construction activities coordination specified in other Sections for work built into walls:
1. Work required under this Section includes chase and routing coordination with construction activities specified in other Sections.
  2. As walls are completed, coordinate with work required in other Sections for chases or routing areas required in AAC walls for electrical, plumbing, and other items.
  3. Request relevant construction activities to mark actual routing or chase locations; include required depth.
  4. Filling in chases and routed areas specified in other Sections.
- 3.2.3.2 PART 2 – PRODUCTS
- 1.1. SUPPLIERS / MANUFACTURERS
- A. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
- B. Substitutions: See Section 016000 - Product Requirements.
- 1.2. MANUFACTURED UNITS
- A. AAC units:
1. Composition: Autoclaved aerated concrete mixture consisting of quartz sand, lime, cement, proprietary additives, and water. Nominal dimensions:



- a. AAC Block; Tongue and Groove: 100mm, 150mm, 200mm, 240mm, 300mm nominal widths by 200mm nominal height by 610mm nominal length; Strength Class AC2, AC4, AC6.
  - b. AAC Block; Flat face head joints: 100mm, 150mm, 200mm, 240mm, 300mm nominal widths by 200mm nominal height by 608mm nominal length; Strength Class AC2, AC4, AC6.
  - c. AAC ValuBlock: 100mm, 150mm, 200mm, 240mm, 300mm nominal widths by 608mm nominal height by 608mm nominal length; Strength Class AC2, AC4, AC6.
  - d. Solid lintel units; reinforced: Same width as walls by 200mm, 300mm, 403mm, 608mm nominal height; Strength Class AC4.
  - e. Lintel "U-Block" units: Same width as walls by 200mm, 240mm nominal height by 608mm nominal length; Strength Class AC4.
- B. Fire ratings: In accordance with UL 263, UL 1479 and UL 2079.
- 1.3. ACCESSORIES
- A. Mortar materials:
- 1. AAC unit head joint and bed joint mortar;
  - 2. Levelling bed mortar: ASTM C 270, Type "M".
  - 3. Aggregate:
    - a. Levelling bed mortar: Clean, hard, natural, washed sand in accordance with ASTM C 144.
    - b. Masonry grout:
      - 1) Fine aggregate: ASTM C 404, Size No. 1
      - 2) Coarse aggregate: ASTM C 404, Size No. 89.
  - 4. Water: Clean, potable, free from deleterious amounts of alkalies, acids, and organic materials.
- B. Reinforcement: ASTM A 615, Grade 60, deformed type for #3 and larger bars; actual sizes indicated on Contract Drawings.
- C. Backer rods and sealants: Specified in Joint Sealants Section.
- D. Flexible flashing;
- E. Fire-rated insulation for penetrations of rates walls: Specified in Firestopping Section.
- F. Tension tie-downs;
- G. Fasteners and Anchors: Compatible with AAC materials.



#### 1.4. MIXES

##### A. Mortar proportions:

1. ACC unit head joint and bed joint mortar: Mix in accordance with manufacturer's mixing instructions.
2. Proportion materials by volume in accordance with ASTM C 270 for levelling course only. Use AAC thin bed mortar for head and bed joints and other joints in AAC work.

##### B. Grout proportions:

1. Fine and Coarse Grout: Proportion materials by volume in accordance with ASTM C 476.
2. Slump: 8" to 11" measured in accordance with ASTM C 143.

#### 3.2.3.3 PART 3 – EXECUTION

##### 1.1. PREPARATION

###### A. Protection:

1. Keep walls dry during erection by covering at end of each work period with non-staining waterproof membrane covering.
2. Protect partially completed walls not being worked on with non-staining waterproof membrane until construction activities specified in other sections completes protection of walls.
3. Covering: Overhang at least 1.8m on each side of wall; anchor on each side of wall.
4. Protect finished exposed work from stains.
5. Take particular care to keep AAC units clean.
6. Brace walls during construction to protect from wind damage.

##### 1.2. INSTALLATION

###### A. Workmanship:

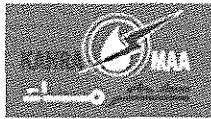
1. Lay AAC units plumb, level, and true to line for range.
2. Lay units in running bond with 150mm minimum head joints lap in alternate courses.
3. Cut AAC units with unit manufacturer recommended hand type saw or electric bandsaw specially designed for cutting AAC units. Lay out units to minimize cutting.

###### B. Building in other work:

1. Install work of other sections required to be incorporated with AAC units as work progresses; include anchors, and accessories. Space and align built-in parts; exercise care not to disturb other materials from position.
2. Coordinate with SEQUENCING AND SCHEDULING Article for required routing and chases.



3. Fill in interior spaces around built-in items with fine grout or interior plaster.
  4. Fill in exterior spaces around built-in items with fine grout or stucco.
  5. Fill hollow metal frames in AAC unit walls with fine grout as wall is laid. Rake back 12mm joint between hollow metal frame and adjacent AAC unit to receive sealant at butt type frames.
- C. Mortar joints:
1. Head and bed joints:
    - a. Lay first course in full bed of leveling bed mortar in thickness necessary to level AAC unit top; not less than 3/8 inch.
    - b. Apply AAC unit head joint and bed joint mortar on full face of AAC unit already laid.
  2. Make adjustment while mortar is still soft and plastic by tapping to plumb and bringing to alignment.
  3. Check each AAC unit as laid with mason's level for level and plumb with wall below.
  4. Remove and replace mortar with fresh mortar, where adjustment must be made after mortar has started to set.
  5. Keep bed and head joints uniform in width.
  6. Standard thickness for both horizontal and vertical mortar joints:
    - a. Base course bed joint: 12mm, nominal, +/- 6mm.
    - b. Other vertical coursing and head joints: 2mm, nominal.
  7. Take particular care to avoid spreading mortar on exposed face of AAC unit. Only normal mortar droppings will be accepted on face of AAC unit; remove only after mortar has dried enough not to smear.
- D. Flexible flashing:
1. Clean AAC unit surfaces smooth; maintain free from projections capable of puncturing flashing material.
  2. Follow requirements indicated in Flexible Flashing Section.
- E. Joint treatment: Remove excess extruded mortar immediately after laying AAC unit; tooling joints is not required.
- F. Control joints:
1. Make joint 12mm wide, unless indicated otherwise, rake out control joints to depth of 20mm while mortar is still plastic.
  2. Provide joints at 7.30m O.C. unless otherwise indicated.
  3. Leave joint open and clean for caulking in accord with Joint Sealants Section.



**G. Tolerances:**

1. Maximum variation from plumb: 6mm in 3.0m; not exceeding 10mm in 6.0m.
2. Maximum variation from level: 6mm in 6.0m, not exceeding 12mm in 15.0m or more.
3. Maximum variation in linear building line from location indicated: 6mm in 6.0m.

**1.3. CLEANING AND PATCHING**

- A. Keep AAC unit work free of mortar droppings as work progresses and, at completion of work, rub AAC unit to remove excess mortar.
- B. Patch AAC units with excessive spalls or chips.

**3.2.4 SECTION 04 81 53 – CAVITY WALLS**

**3.2.4.1 PART 1 - GENERAL**

**1.1. SECTION INCLUDES**

- A. Concrete Block.
- B. Reinforcement and Anchorage.
- C. Flashings.
- D. Lintels.
- E. Accessories.

**1.2. RELATED REQUIREMENTS**

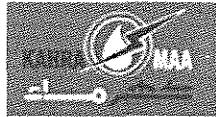
A. Related requirements as referenced:

1. Concrete Reinforcement – Civil & Structural Specifications.
2. Section 040653 - Mortar and Masonry Grout.
3. Section 072100 - Thermal Insulation: Insulation for cavity spaces.
4. Section 078413 - Firestopping: Firestopping at penetrations of masonry work.
5. Section 079200 - Joint Sealers: Backing rod and sealant at control and expansion joints.

**1.3. REFERENCE STANDARDS**

A. Standards of the following as referenced:

1. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International; 2005.
2. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; American Concrete Institute International; 2005.



3. ASTM A 82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
  4. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
  5. ASTM A 580/A 580M - Standard Specification for Stainless Steel Wire; 2006.
  6. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2007.
  7. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.
  8. ASTM C 90 - Standard Specification for Load bearing Concrete Masonry Units; 2006b.
  9. ASTM C 91 - Standard Specification for Masonry Cement; 2005.
  10. ASTM C 129 - Standard Specification for Non-load bearing Concrete Masonry Units; 2006.
  11. ASTM C 140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2007a.
  12. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar; 2004.
  13. ASTM C 150 - Standard Specification for Portland Cement; 2007.
  14. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2007a.
  15. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout; 2007.
  16. ASTM C 476 - Standard Specification for Grout for Masonry; 2007.
  17. ASTM C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2007a.
  18. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2006.
  19. IMIAWC (HW) - Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.
- 1.4. SUBMITTALS**
- A. See Section 013000 - Administrative Requirements, for submittal procedures.
  - B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.
  - C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- 1.5. QUALITY ASSURANCE**
- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.



1. Maintain one copy of each document on project site.

**1.6. MOCK-UP**

- A. Construct a masonry cavity wall as a mock-up panel sized 2.4 m long by 1.8 m high; include mortar and accessories, reinforcement, flashings, and wall insulation in mock-up.
- B. Locate where directed.

**1.7. PRE-INSTALLATION MEETING**

- A. Convene as directed by Engineer before starting work of this section.

**1.8. DELIVERY, STORAGE, AND HANDLING**

- A. Follow Manufacturer's instructions on delivery, storage and handling.

**1.9. FIELD CONDITIONS**

- A. Follow Manufacturer's instructions on field conditions.

**3.2.4.2 PART 2 - PRODUCTS**

**1.1. CONCRETE MASONRY UNITS**

- A. Concrete Block: Comply with referenced standards and as follows:

1. Size: Standard units with nominal face dimensions of 400 x 200 mm and nominal depths as indicated on the drawings for specific locations.
2. Special Shapes: Provide non-standard blocks configured for corners.
3. Non-Load-bearing Units: ASTM C 129.
  - a. Hollow block, as indicated.

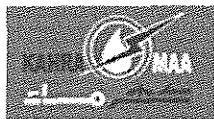
**1.2. MORTAR AND GROUT MATERIALS**

- A. Mortar and Grout: As specified in Section 040653.

**1.3. REINFORCEMENT AND ANCHORAGE**

- A. Manufacturers of Joint Reinforcement and Anchors:

1. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  2. Substitutions: See Section 016000 - Product Requirements.
- B. Reinforcing Steel: size as indicated on drawings and Civil & Structural Specifications; galvanized finish.
- C. Multiple Wythe Joint Reinforcement: Truss type; fabricated with moisture drip; ASTM A 82/A 82M steel wire, hot dip galvanized after fabrication to ASTM A 153/A 153M, Class B; 3.8 mm side rods



with 3.8 mm cross rods; width as required to provide not more than 25 mm and not less than 13 mm of mortar coverage on each exposure.

#### 1.4. FLASHINGS

- A. Pre-Coated Galvanized Steel: ASTM A 653/A 653M, with G90/Z275 coating, 0.61 mm total thickness, shop pre-coated with fluoropolymer coating in colour matching masonry.

#### 1.5. ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

1. Manufacturers:

- a. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.

- b. Substitutions: See Section 016000 - Product Requirements.

2. Joint Filler: Closed cell polyvinyl chloride; oversized 50% to joint width; self-expanding; mm wide x by maximum lengths available.

3. Building Paper: ASTM D 226, Type I ("No. 15") asphalt felt.

4. Nailing Strips: Preservative treated softwood, as specified in Section 061000.

5. Weeps: Moulded PVC grilles, insect resistant.

a. Manufacturers:

- 1) Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in.

- 2) Substitutions: See Section 016000 - Product Requirements.

6. Cavity Vents: Moulded PVC grilles, insect resistant.

7. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

#### 1.6. LINTELS

- A. Lintels as per structural details.

#### 3.2.4.3 PART 3 - EXECUTION

##### 1.1. EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.

- B. Verify that related items provided under other sections are properly sized and located.

- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

##### 1.2. PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.



- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

**1.3. COURSING**

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
1. Bond: Running.
  2. Coursing: One unit and one mortar joint to equal 200 mm.
  3. Mortar Joints: Raked.

**1.4. PLACING AND BONDING**

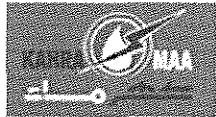
- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar as work progresses.
- E. Interlock intersections and external corners, except for units laid in stack bond.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, un-chipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

**1.5. WEEPS/CAVITY VENTS**

- A. Install weeps in cavity walls at 600 mm on centre horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
- B. Install cavity vents in cavity walls at 800 mm on centre horizontally below shelf angles and lintels and at top of walls.

**1.6. CAVITY WALL CONSTRUCTION**

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.



- B. Build inner wythe ahead of outer wythe to receive accessories.

**1.7. REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY**

- A. Install horizontal joint reinforcement 400 mm on centre.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of openings.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 150 mm.
- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 600 mm horizontally and 400 mm vertically.
- F. Reinforce stack bonded unit joint corners and intersections with strap anchors 400 mm on centre.

**1.8. MASONRY FLASHINGS**

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
- B. Extend metal flashings to within 6 mm of exterior face of masonry.

**1.9. LINTELS**

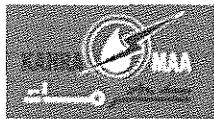
- A. Reinforced block lintels.
  - 1. Reinforced block lintels, may be used as substitute for pre-cast lintels only on written approval of Engineer.
  - 2. Fabricate pre-cast concrete block lintels in accordance with shop drawings approved by Engineer.
  - 3. Set reinforcement bars as per shop drawings and fill void of block with concrete grout.
  - 4. Maintain normal vertical joint spacing and point joints with mortar.
  - 5. Allow lintels to cure before lifting and building into wall.

**1.10. CONTROL AND EXPANSION JOINTS**

- A. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

**1.11. BUILT-IN WORK**

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.



1. Fill adjacent masonry cores with grout minimum 300 mm from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

#### **1.12. CUTTING AND FITTING**

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

#### **1.13. FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 014000.
- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C 140 for conformance to requirements of this specification.
- C. Mortar Tests: Test each type of mortar in accordance with recommended procedures in ASTM C 780, testing with same frequency as masonry samples.

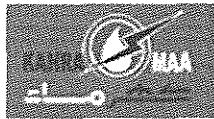
#### **1.14. CLEANING**

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

#### **1.15. PROTECTION**

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

**END OF SECTION 04 81 53**



### **3.3 DIVISION 05 METALS**

#### **3.3.1 SECTION 05 51 00 - METAL STAIRS**

##### **3.3.1.1 PART 1 – GENERAL**

###### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

###### **1.2. SUMMARY**

###### **A. Section Includes:**

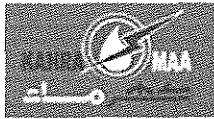
1. Preassembled steel stairs with concrete-filled, precast concrete, epoxy-resin-filled and abrasive-coating-finished formed-metal treads.
2. Industrial-type stairs with steel floor plate grating treads.
3. Ornamental steel-framed stairs.
4. Steel tube railings attached to metal stairs.
5. Steel tube handrails attached to walls adjacent to metal stairs.
6. Railing gates at the level of exit discharge.

###### **B. Related Sections:**

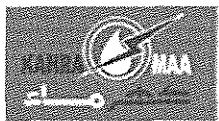
1. Section 033000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Section 055000 "Metal Fabrications" for metal treads and nosings installed at locations other than in metal stairs and alternating tread devices.
3. Section 055213 "Pipe and Tube Railings" for pipe and tube railings not attached to metal stairs or to walls adjacent to metal stairs.
4. Section 057113 "Fabricated Metal Spiral Stairs."
5. Section 057300 "Decorative Metal Railings" for ornamental metal railings.
6. Section 061000 "Rough Carpentry" Section 061053 "Miscellaneous Rough Carpentry" for wood blocking for anchoring railings.
7. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.
8. Section 102213 "Wire Mesh Partitions" for wire mesh security partitions and doors.

###### **1.3. PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
  2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
  3. Uniform and concentrated loads need not be assumed to act concurrently.
  4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.



5. Limit deflection of treads, platforms, and framing members to L/240 L/360 or 1/4 inch (6.4 mm), whichever is less.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
  1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq/ft. (0.093 sq/m).
    - b. Infill load and other loads need not be assumed to act concurrently.
- D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. Component Importance Factor is 1.5.
- 1.4. ACTION SUBMITTALS
- A. Product Data: For metal stairs and the following:
  1. Prefilled metal-pan stair treads.
  2. Precast concrete treads.
  3. Epoxy-resin-filled stair treads.
  4. Nonslip aggregates and nonslip-aggregate finishes.
  5. Abrasive nosings.
  6. Metal floor plate treads.
  7. Paint products.
  8. Grout.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For products involving selection of colour, texture, or design.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes:
  1. Precast concrete treads.
  2. Epoxy-resin-filled stair treads.
  3. Stair treads with nonslip-aggregate surface finish.
  4. Metal floor plate treads.
  5. Grating treads.
  6. Abrasive nosings.
- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.5. INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified professional engineer testing agency.
- B. Welding certificates.



C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs and railings.

1. Test railings according ASTM E 894 and ASTM E 935.

**1.6. QUALITY ASSURANCE**

A. Installer Qualifications: Fabricator of products. NAAMM standard in first paragraph below includes only minimal requirements.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Preassembled Stairs: Service class.

2. Industrial-Type Stairs: Industrial class.

3. Ornamental Stairs: Architectural class.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.3, "Structural Welding Code - Sheet Steel."

**1.7. COORDINATION**

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

**3.3.1.2 PART 2 – PRODUCTS**

**1.1. METALS, GENERAL**

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

**1.2. FERROUS METALS**

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

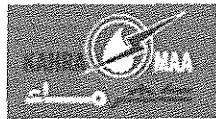


- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.
- E. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- F. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).
- G. Cast Iron: Either grey iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- H. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- I. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
- J. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.
- K. Expanded-Metal, Carbon Steel: ASTM F 1267, Type I (expanded) Type II (expanded and flattened), Class 1 (uncoated).
  - 1. Style Designation: 3/4 number 13 1-1/2 number 10.
- L. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, 0.060 inch (1.52 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows with 1/8-by-1-inch (3.2-by-25.4-mm) round end slotted holes in staggered rows.
- M. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, G90 (Z275) coating, commercial steel Type B, 0.064 inch (1.63 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.
- N. Woven-Wire Mesh: Intermediate-crimp, diamond square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).

#### 1.3. NONFERROUS METALS

- A. Aluminium Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- B. Aluminium Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- C. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- D. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- E. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20% leaded nickel bronze).

#### 1.4. ABRASIVE NOSINGS



- A. Cast-Metal Units: Cast, with an integral abrasive, as-cast finish consisting of aluminium oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
    - 1. Configuration: Cross-hatched units, 4 inches (100 mm) wide without lip.
    - 2. Configuration: Cross-hatched angle-shaped units, same depth as bar-grating treads and 1 to 1-1/2 inches (25 to 38 mm) wide.
  - B. Extruded Units: Aluminium units with abrasive filler consisting of aluminium oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
    - 1. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminium extrusion.
    - 2. Nosings: Two-piece units, 3 inches (75 mm) wide, with subchannel for casting into concrete.
  - C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
  - D. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
  - E. Apply clear lacquer to concealed surfaces of extruded units set into concrete.
- 1.5. FASTENERS
- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
  - B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
  - C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
    - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs, stairs indicated to be galvanized and stairs indicated to be shop primed with zinc-rich primer.
  - D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
  - E. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).
  - F. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
  - G. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M). If retaining paragraph below, indicate loads on Drawings and verify safety factors with Project's structural engineer.
  - H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
    - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.



2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

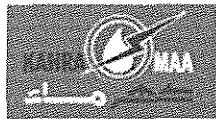
#### **1.6 MISCELLANEOUS MATERIALS**

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers
- C. Shop Primers: Provide primers that comply with Section 09900 "Paints and Coatings" and Section 099600 "High-Performance Coatings."
- D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Non-shrink, Non-metallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.
- J. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminium-oxide grits or crushed emery; rustproof and non-glazing; unaffected by freezing, moisture, or cleaning materials.
- K. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

#### **1.7 PRECAST CONCRETE TREADS**

- A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 5000 psi (35 MPa) and a total air content of not less than 4% or more than 6%.
- B. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50 by 50 mm) by 0.062-inch- (1.6-mm-) diameter wire; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

#### **1.8 FABRICATION, GENERAL**



- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
  - 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint, Type 2 welds: completely sanded joint, some undercutting and pinholes okay, Type 3 welds: partially dressed weld with spatter removed, Type 4 welds: good quality, uniform undressed weld with minimal splatter.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

#### 1.9. STEEL-FRAMED STAIRS

- A. Stair Framing:
  - 1. Fabricate stringers of steel plates, channels, plates or channels.
  - 2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
  - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
  - 4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and



struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

#### **1.10. STAIR RAILINGS**

- A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."
- B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
  1. Rails and Posts: as shown on drawings.
  2. Picket Infill: 1/2-inch- (13-mm-) square pickets spaced less than 4 inches (100 mm) clear.
  3. Intermediate Rails Infill: as shown on drawings.
  4. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with cam-type, self-closing hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.
- C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- D. Form changes in direction of railings as follows:
  1. As detailed.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
  1. Connect posts to stair framing by direct welding unless otherwise indicated.
  2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
  3. For non-galvanized railings, provide non-galvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

#### **2.1. FINISHES**



- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  - 2. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
  - 1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."
- E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

#### **3.3.1.3 PART 3 – EXECUTION**

##### **1.1. INSTALLATION, GENERAL**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of racking.
- C. Delete first paragraph below if other fastening methods are acceptable.
- D. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- G. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- H. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."



1. Install abrasive nosings with anchors fully embedded in concrete. Centre nosings on tread width.
- I. Install precast concrete treads with adhesive supplied by manufacturer.
- 1.2. **INSTALLING METAL STAIRS WITH GROUTED BASEPLATES**
  - A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
  - B. Set steel stair baseplates on wedges, shims, or levelling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
    1. Use non-metallic, non-shrink grout unless otherwise indicated.
    2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- 1.3. **INSTALLING RAILINGS**
  - A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction.
  - B. Anchor posts to steel by welding directly to steel supporting members.
  - C. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.
  - D. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
- 1.4. **ADJUSTING AND CLEANING**
  - A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
  - B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09900 "Paints and Coatings" Section 099600 "High-Performance Coatings."
  - C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

### **3.3.2 SECTION 05 52 13 – PIPE AND TUBE RAILINGS**

#### **3.3.2.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**



- A. Wall mounted handrails.
- B. Stair railings and guardrails.
- C. Free-standing railings at steps.
- D. Balcony railings and guardrails.

#### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:

1. Civil & Structural Specifications - Cast-in-Place Concrete: Placement of anchors in concrete.
2. Section 042000 - Unit Masonry Assemblies: Placement of anchors in masonry.
3. Section 099000 – Paints & Coatings.

#### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminium Extrusions and Panels; 2002.
2. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminium Extrusions and Panels; 2005.
3. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminium Extrusions and Panels; 2005.
4. ASTM A 53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.
5. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
6. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2007.
7. ASTM A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2007.
8. ASTM B 211 - Standard Specification for Aluminium and Aluminium-Alloy Bar, Rod, and Wire; 2003.
9. ASTM B 211M - Standard Specification for Aluminium and Aluminium-Alloy Bar, Rod, and Wire (Metric); 2003.
10. ASTM B 221M - Standard Specification for Aluminium and Aluminium-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2007.
11. ASTM B 241/B 241M - Standard Specification for Aluminium and Aluminium-Alloy Seamless Pipe and Seamless Extruded Tube; 2002.



12. ASTM B 429/B 429M - Standard Specification for Aluminium-Alloy Extruded Structural Pipe and Tube; 2006.
13. ASTM B 483/B 483M - Standard Specification for Aluminium and Aluminium-Alloy Drawn Tubes and Pipe for General Purpose Applications; 2003.
14. ASTM E 935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2000 (Re-approved 2006).
15. ASTM E 985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Re-approved 2006).
16. SSPC-Paint 15 - Steel Joist Shop Paint; the Society for Protective Coatings; 1999 (Ed. 2004).
17. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); The Society for Protective Coatings; 2002 (Ed. 2004).

#### 1.4. SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Samples: Submit two, 600 mm. long samples of handrail. Submit two samples of elbow, wall bracket, and end stop.

#### 3.3.2.2 PART 2 - PRODUCTS

##### 1.1. RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E 985 and applicable local code.
- B. Design railing assembly, wall rails, and attachments to resist lateral force of 333 N at any point without damage or permanent set.
- C. Allow for expansion and contraction of members and building movement without damage to connections or members.
- D. Dimensions: See drawings for configurations and heights.
- E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
  1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
  2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.
  3. For anchorage to stud walls, provide backing plates, for bolting anchors.

##### 1.2. ALUMINIUM MATERIALS



- A. Aluminium Pipe: Schedule 40; ASTM B 429/B 429M, ASTM B 241/B 241M, or ASTM B 483/B 483M.
- B. Aluminium Tube: Minimum wall thickness of 3.2 mm; ASTM B 429/B 429M, ASTM B 241/B 241M, or ASTM B 483/B 483M.
- C. Solid Bars and Flats: ASTM B 211 (ASTM B 211M).
- D. Exposed Fasteners: No exposed bolts or screws.

#### **1.3 STEEL RAILING SYSTEM**

- A. Steel Pipe: ASTM A 53/A53M, Grade B Schedule 40, black finish.
- B. Stainless Steel. To meet specified requirements of AISI Type 316 for external use and AISI Type 304 for internal use,
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Exposed Fasteners: No exposed bolts or screws.
- E. Galvanizing: In accordance with requirements of ASTM A 123/A 123M.
  - a. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

#### **1.4 FABRICATION**

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
  1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
  2. Interior Components: Continuously seal joined pieces by continuous welds.
  3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Stainless Steel Fabrication.
  1. Fabricate components incorporating stainless steel exposed to view with the rolling direction the same for each component type throughout.
  2. Isolate fabrication of stainless steel from other areas where carbon steel is worked to ensure that no carbon steel dust is embedded into stainless steel.



3. Use tools and dies which have been used on carbon steels only after they have been thoroughly cleaned.
4. Do not cut or form stainless steel with tools or dies that are nicked or damaged.
5. Ensure that backup of stainless steel will maintain or improve specified flatness without telegraphing of fasteners and similar distortions.

#### **1.5. ALUMINIUM FINISHES**

- A. Polyester powder coating (PPC) to comply with AAMA 2604.
  1. Corro-Coat PE-SDF Super Durable by Jotun Powder Coatings.
  2. Or equivalent approved.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

#### **3.3.2.3 PART 3 - EXECUTION**

##### **1.1. EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

##### **1.2. PREPARATION**

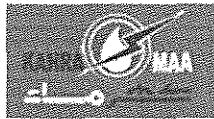
- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.
- C. Apply one coat of bituminous paint to concealed aluminium surfaces that will be in contact with cementitious or dissimilar materials.

##### **1.3. INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.
- D. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.
- E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

##### **1.4. TOLERANCES**

- A. Maximum Variation From Plumb: 6 mm per floor level, non-cumulative.
- B. Maximum Offset from True Alignment: 6 mm.
- C. Maximum Out-of-Position: 6 mm.



## 1.5. SCHEDULE

- A. Refer Schedule of Handrails and Railings, if included; otherwise refer drawings for relevant information.

### **3.3.3 SECTION 05 53 00 - METAL GRATINGS**

#### **3.3.3.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Formed metal fall protection gratings in the mechanical shafts.
- B. Perimeter closure.

##### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:

1. Civil & Structural Specifications - Cast-in-Place Concrete.
2. Section 099000 – Paints & Coatings.

##### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. ASTM A 36/A36M - Standard Specification for Carbon Structural Steel; 2005
2. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
3. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
4. ASTM A 786/A 786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2005.
5. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2007.
6. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2006 and Errata.
7. NAAMM MBG 531 - Metal Bar Grating Manual; The National Association of Architectural Metal Manufacturers; 2000 (ANSI/NAAMM MBG 531).
8. NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual; The National Association of Architectural Metal Manufacturers; 2000 (ANSI/NAAMM MBG 532).
9. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

##### **1.4. PERFORMANCE REQUIREMENTS**



- A. Conform to applicable code for loading requirements.
  - B. Maximum Allowable Deflection Under Live Load: 1/240; size components by single support design.
- 1.5. SUBMITTALS**
- A. See Section 013000 - Administrative Requirements, for submittal procedures.
  - B. Product Data: Provide span and deflection tables.
  - C. Shop Drawings: Indicate details of component supports, openings, perimeter construction details, and tolerances.
    - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
  - D. Samples: Submit two samples, 600x600 mm in size illustrating surface finish, colour, and texture.
  - E. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
  - F. Manufacturer's Installation Instructions: Indicate special requirements for opening and perimeter framing.
- 1.6. QUALITY ASSURANCE**
- A. Designer Qualifications: Design gratings and plates under direct supervision of a licensed Professional Engineer experienced in design of this type of work.
- 1.7. PROJECT CONDITIONS**
- A. Verify that field measurements are as per indicated on drawings.
  - B. Coordinate the work with placement of frames, tolerances for placed frames.
- 3.3.3.2 PART 2 - PRODUCTS**
- 1.1. MATERIALS**
- A. Steel Floor Plate: ASTM A 786/A 786M; pattern as indicated.
  - B. Steel For Welding or Riveting: ASTM A 36/A 36M, galvanized, of rectangular shape.
  - C. Steel Framing: ASTM A 36/A36M shapes, galvanized per ASTM A 123/A 123M.
  - D. Cross Bars: ASTM B 211 (ASTMB 211M) solid bars.
  - E. Welding Materials: AWS D1.1; type required for materials being welded.
  - F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- 1.2. ACCESSORIES**
- A. Perimeter Closure: Of same material as grating.



**1.3. FABRICATION**

- A. Fabricate grates and plates to accommodate design loads.
- B. Weld joints of intersecting metal sections.
- C. Fabricate support framing for openings.

**1.8. FINISHES**

- A. Galvanizing for Steel Shapes: ASTM A 123/A 123M.
- B. Galvanizing for Steel Hardware: ASTM A 153/A 153M.

**3.3.3.3 PART 3 - EXECUTION**

**1.1. EXAMINATION**

- A. Verify that opening sizes and dimensional tolerances are acceptable.
- B. Verify that supports are correctly positioned.

**1.2. INSTALLATION**

- A. Install components in accordance with manufacturer's instructions.
- B. Place frames in correct position, plumb and level.
- C. Mechanically cut galvanized finish surfaces. Do not flame cut.
- D. Anchor by welding.
- E. Set perimeter closure flush with top of grating and surrounding construction.
- F. Secure to prevent movement.



### **3.4 DIVISION 06 WOOD, PLASTIC & COMPOSITES**

#### **3.4.1 SECTION 06 10 00 - ROUGH CARPENTRY**

##### **3.4.1.1 PART 1 – GENERAL**

###### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

###### **1.2. SUMMARY**

###### **A. Section Includes:**

1. Framing with dimension lumber.
2. Framing with timber.
3. Framing with engineered wood products.
4. Shear wall panels.
5. Rooftop equipment bases and support curbs.
6. Wood blocking, cants, and nailers.
7. Wood furring and grounds.
8. Wood sleepers.
9. Utility shelving.
10. Plywood backing panels.

###### **1.3. DEFINITIONS**

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- C. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.

###### **1.4. ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
- B. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
- C. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
- D. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
- E. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.



- F. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- 1.5. **INFORMATIONAL SUBMITTALS**
- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated wood.
  2. Fire-retardant-treated wood.
  3. Engineered wood products.
  4. Shear panels.
  5. Power-driven fasteners.
  6. Powder-actuated fasteners.
  7. Expansion anchors.
  8. Metal framing anchors.
- 1.6. **QUALITY ASSURANCE**
- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- 1.7. **DELIVERY, STORAGE, AND HANDLING**
- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- 3.4.1.2 PART 2 – PRODUCTS
- 1.1. **WOOD PRODUCTS, GENERAL**
- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
  3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  4. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15% for 2-inch nominal (38-mm actual) thickness or less, 19% for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.



C. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

**1.2. WOOD-PRESERVATIVE-TREATED LUMBER**

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19%. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat all rough carpentry unless otherwise indicated.

**1.3. FIRE-RETARDANT-TREATED MATERIALS**

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centreline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.



3. Interior Type A: Treated materials shall have a moisture content of 28% or less when tested according to ASTM D 3201 at 92% relative humidity. Use where exterior type is not indicated.
  4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19%. Kiln-dry plywood after treatment to a maximum moisture content of 15%.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.
  - E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
  - F. Application: Treat [all rough carpentry unless otherwise indicated.]
- 1.4. DIMENSION LUMBER FRAMING
- A. Non-Load-Bearing Interior Partitions: Construction, Stud, or No. 3 grade.
1. Application: Interior partitions not indicated as load-bearing.
- B. Load-Bearing Partitions: Construction, Stud, or No. 3 grade.
1. Application: Exterior walls and interior load-bearing partitions.
- C. Load-Bearing Partitions: Any species of machine stress-rated dimension lumber with a grade of not less than 2400f-2.0E 2100f-1.8E 1650f-1.5E.
1. Application: Exterior walls and interior load-bearing partitions.
- D. Ceiling Joists: Construction, Stud, or No. 3 grade.
- E. Joists, Rafters, and Other Framing Not Listed Above: Construction, Stud, or No. 3 grade.
- F. Joists, Rafters, and Other Framing Not Listed Above: Any species of machine stress-rated dimension lumber with a grade of not less than 2400f-2.0E 2100f-1.8E 1650f-1.5E.
- G. Provide timber framing complying with the following requirements, according to grading rules of grading agency indicated:
1. Species and Grade: Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; Select Structural No. 1 grade; NLGA, WCLIB, or WWPA.
  2. Species and Grade: Eastern hemlock, eastern hemlock-tamarack, or eastern hemlock-tamarack (north); Select Structural No. 1 grade; NeLMA or NLGA.
  3. Species and Grade: Hem-fir or hem-fir (north); Select Structural No. 1 grade; NLGA, WCLIB, or WWPA.
  4. Species and Grade: Mixed maple; Select Structural No. 1 grade; NeLMA.
  5. Species and Grade: Mixed oak; Select Structural No. 1 grade; NeLMA.



6. Species and Grade: Southern pine; Select Structural No. 1 grade; SPIB.
  7. Maximum Moisture Content: 20%.
  8. Additional Restriction: Free of heart centres.
- 1.5. ENGINEERED WOOD PRODUCTS**
- A. Engineered Wood Products, General: Products shall contain no urea formaldehyde.
  - B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
  - C. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
  - D. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
  - E. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Provide units complying with material requirements of and with structural capacities established and monitored according to ASTM D 5055.
    1. Structural Properties: Provide units with depths and design values not less than those indicated.
    2. Provide units complying with APA PRI-400, factory marked with APA trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA standard.
  - F. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.
    1. Manufacturer: Provide products by same manufacturer as I-joists.
    2. Material: All-veneer product.
    3. Thickness: 1 inch (25 mm).
    4. Provide performance-rated product complying with APA PRR-401, rim board plus grade, factory marked with APA trademark indicating thickness, grade, and compliance with APA standard.
- 1.6. SHEAR WALL PANELS**
- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.
  - B. Wood-Framed Shear Wall Panels: Prefabricated assembly consisting of wood perimeter framing, tie downs, and Exposure I, Structural I plywood or OSB sheathing.
  - C. Steel-Framed Shear Wall Panels: Prefabricated assembly consisting of cold-formed galvanized steel panel, steel top and bottom plates, and wood studs.
  - D. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, Manufacturer's published values shall be determined from empirical data or by



rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

#### **1.7. MISCELLANEOUS LUMBER**

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Rooftop equipment bases and support curbs.
  - 4. Cants.
  - 5. Furring.
  - 6. Grounds.
  - 7. Utility shelving.
- B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber.
- C. For utility shelving, provide lumber with 15% maximum moisture content.
- D. For concealed boards, provide lumber with 15% maximum moisture.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- G. For furring strips for installing plywood or hardboard panelling, select boards with no knots capable of producing bent-over nails and damage to panelling.

#### **1.8. FASTENERS**

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preserved treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.



1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
  2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).
- 1.9. METAL FRAMING ANCHORS**
- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.
  - B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
  - C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
    1. Use for interior locations unless otherwise indicated.
  - D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
    1. Use for wood-preservative-treated lumber and where indicated.
  - E. Stainless-Steel Sheet: ASTM A 666, Type 304 Type 316.
    1. Use for exterior locations and where indicated.
  - F. Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges at least 85 percent of joist depth.
  - G. I-Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
  - H. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
  - I. Bridging: Rigid, V-section, nailless type, 0.050 inch (1.3 mm) thick, length to suit joist size and spacing.
  - J. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch (25 mm) above base and with 2-inch- (50-mm-) minimum side cover, socket 0.062 inch (1.6 mm) thick, and standoff and adjustment plates 0.108 inch (2.8 mm) thick.
  - K. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
  - L. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.
  - M. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches (57 mm) wide by 0.062 inch (1.6 mm) thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.



- N. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches (32 mm) wide by 0.050 inch (1.3 mm) thick by 36 inches (914 mm) long.
- O. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.
- P. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches (29 mm) wide by 9/16 inch (14 mm) deep by 0.034 inch (0.85 mm) thick with hemmed edges.
- Q. Wall Bracing: Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch (24 by 24 by 1 mm) thick with hemmed edges.

#### 1.10 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
- E. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

#### 3.4.1.3 PART 3 – EXECUTION

##### 1.1. INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.



- F. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- H. Do not splice structural members between supports unless otherwise indicated.
- I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
  - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.
  - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
  - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.
- K. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- L. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
  - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- N. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.



- O. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
  - 1. Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
  - 2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
  - 3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.
- 1.2. **WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION**
  - A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
  - B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
  - C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
  - D. Provide permanent grounds of dressed, pressure-preservative-treated, key-bevelled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.
- 1.3. **WOOD FURRING INSTALLATION**
  - A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
  - B. Furring to Receive Plywood or Hardboard Panelling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally and vertically at 600 mm o.c.
  - C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 400 mm o.c.
- 1.4. **WALL AND PARTITION FRAMING INSTALLATION**
  - A. General: Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.
  - B. Construct corners and intersections with three or more studs[, except that two studs may be used for interior non-load-bearing partitions].
  - C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
- 1.5. **FLOOR JOIST FRAMING INSTALLATION**



- A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches (38 mm) of bearing on wood or metal, or 3 inches (76 mm) on masonry. Attach floor joists as follows:
  - 1. Where supported on wood members, by toe nailing or by using metal framing anchors.
  - 2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.
- B. Fire Cuts: At joists built into masonry, bevel cut ends 3 inches (76 mm) and do not embed more than 4 inches (102 mm).
- C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches (1200 mm).
- D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches (50 mm) from top or bottom.
- E. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist at ends of joists unless nailed to header or band.
- F. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches (102 mm) or securely tie opposing members together. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist over supports.
- G. Anchor members paralleling masonry with 1/4-by-1-1/4-inch (6.4-by-32-mm) metal strap anchors spaced not more than 96 inches (2438 mm) o.c., extending over and fastening to three joists. Embed anchors at least 4 inches (102 mm) into grouted masonry with ends bent at right angles and extending 4 inches (102 mm) beyond bend.
- H. Provide solid blocking between joists under jamb studs for openings.
- I. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
  - 1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.
- J. Provide bridging of type indicated below, at intervals of 96 inches (2438 mm) o.c., between joists.
  - 1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal- (19-by-64-mm actual-) size lumber, double-crossed and nailed at both ends to joists.
  - 2. Steel bridging installed to comply with bridging manufacturer's written instructions.

#### **1.6. CEILING JOIST AND RFTER FRAMING INSTALLATION**

- A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
  - 1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- (19-by-184-mm actual-) size or 2-by-4-inch nominal- (38-by-89-mm actual-) size stringers spaced 48 inches (1200 mm) o.c. crosswise over main ceiling joists.



- B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
  - 1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against valley rafters.
  - 2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against hip rafter.
- C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal- (19-by-140-mm actual-) size boards between every third pair of rafters, but not more than 48 inches (1219 mm) o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.
- D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

#### **1.7. TIMBER FRAMING INSTALLATION**

- A. Install timber with crown edge up and provide not less than 4 inches (102 mm) of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports as indicated if not continuous.
- B. Where beams or girders are framed into pockets of exterior concrete or masonry walls, provide 1/2-inch (13-mm) air space at sides and ends of wood members.
- C. Install wood posts using metal anchors indicated.
- D. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

#### **1.8. PROTECTION**

- R. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- S. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

### **3.4.2 SECTION 06 20 23 – FINISH CARPENTRY**

#### **3.4.2.1 PART 1 - GENERAL**

##### **1.1. SUMMARY**

- A. Section includes finish carpentry items; wood door frames, glazed frames; wood casings and mouldings; and hardware and attachment accessories.
- B. Related Sections:



1. Section 064113 - Custom Cabinets: Shop fabricated custom cabinet work.
  2. Section 081416 - Flush Wood Doors.
  3. Section 088000 - Glazing.
  4. Section 099000 - Paints and Coatings: Finishing of finish carpentry items.
- 1.2. REFERENCES**
- A. Related requirements as referenced:
1. American National Standards Institute:
    - a. ANSI A135.4 - Basic Hardboard.
    - b. ANSI A156.9 - Cabinet Hardware.
    - c. ANSI A208.1 - Mat-Formed Wood Particleboard.
  2. APA-The Engineered Wood Association:
    - a. APA/EWAPS1 - Voluntary Product Standard for Construction and Industrial Plywood.
  3. ASTM International:
    - a. ASTM C1036 - Standard Specification for Flat Glass.
    - b. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
    - c. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  4. Architectural Woodwork Institute:
    - a. AWI - Quality Standards Illustrated.
  5. American Wood-Preservers' Association:
    - a. AWPA C1 - All Timber Products - Preservative Treatment by Pressure Process.
  6. Federal Specification Unit:
    - a. FS A-A-1936 - Adhesive, Contact, Neoprene Rubber.
  7. Hardwood Plywood and Veneer Association:
    - a. HPVAHP-1 - American National Standard for Hardwood and Decorative Plywood.
  8. National Institute of Standards and Technology:
    - a. NIST PS 20 - American Softwood Lumber Standard.
  9. National Electrical Manufacturers Association:
    - a. NEMA LD 3 - High Pressure Decorative Laminates.
  10. Window and Door Manufacturers Association:
    - a. WDMA I.S.4 - Water-Repellent Treatment for Millwork.
  11. Woodwork Institute of California:
    - a. WIC - Manual of Millwork.
- 1.3. SUBMITTALS**
- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories to minimum scale of (1:8).



- C. Product Data:
    - 1. Submit data on fire retardant treatment materials and application instructions.
    - 2. Submit data on attachment hardware and/or finish hardware.
  - D. Samples:
    - 1. Submit two samples of finish plywood, 200 x 250 mm in size illustrating wood grain and specified finish.
    - 2. Submit two samples of wood trim 250 mm long.
    - 3. Submit two samples of laminates, pre-finished paneling, synthetic surfacing, hardware items, and/or shop finishes.
  - E. Certification: Submit copy of fabricator's authorization to use AWI Grade Stamps, AWI Quality Certification Program license and Project specific letters and/or WIC certified compliance certificate.
- 1.4. QUALITY ASSURANCE**
- A. Perform work in accordance with AWI(Architectural Woodwork Institute) Architectural Woodwork Quality Standards Illustrated, Economy, Custom and/or Premium Grade, and/or WIC (Woodwork Institute of California) Manual of Millwork, Economy, Custom and/or Premium Grade.
  - B. Maintain one copy of each document on site.
- 1.5. QUALIFICATIONS**
- A. Fabricator: Company specializing in fabricating Products specified in this section with minimum ten years documented experience.
- 1.6. MOCKUP**
- A. Section 014000 - Quality Requirements: Mockup requirements.
  - B. Construct mockups, full size including all hardware and attachment accessories.
  - C. Locate where directed by the Engineer.
  - D. Remove mockup when directed by the Engineer.
- 1.7. PRE-INSTALLATION MEETINGS**
- A. Section 013100 - Administrative Requirements: Pre-installation meeting.
  - B. Convene minimum one week prior to commencing work of this section.
- 1.8. DELIVERY, STORAGE, AND HANDLING**
- A. Section 016000 - Product Requirements: Product storage and handling requirements.
  - B. Protect work from moisture damage.
- 1.9. FIELD MEASUREMENTS**
- A. Verify field measurements prior to fabrication.
- 1.10. SEQUENCING**
- A. Sequence work to ensure utility connections are achieved in orderly and expeditious manner.



#### **1.11. COORDINATION**

- A. Section 013100 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

#### **1.12. WARRANTY**

- A. Section 017700 – Close out submittals for additional warranty requirements.

#### **3.4.2.2 PART 2 - PRODUCTS**

##### **1.1. FINISH CARPENTRY**

- A. Manufacturer: Any locally available and recognized manufacturer having an official technical data and approved description in conformity with standards for the product herein.

##### **1.2. COMPONENTS**

- A. Softwood and/or Hardwood Lumber: NIST PS 20, and/or AWIGrade III, II and/or I, WIC Economy, Custom or Premium Grade; maximum moisture content of 6 to 8 %.

- B. Softwood and/or Hardwood Plywood: APA/EWA PS 1 Grade (C-D) softwood plywood, HPVA HP-1 hardwood plywood, AWI Grade B, A, and/or AA veneer; and/or WIC Economy, Custom or Premium veneer; with particleboard, medium density fiberboard, veneer or lumber core; type of glue recommended for application.

- C. High Pressure Decorative Laminate: NEMALD3, GP50 for horizontal surfaces, GP28 for vertical surfaces, CL20 for cabinet liner surfaces, BK20 for undecorated backing sheets, PF42 for post forming, FR50 for fire-retardant surfaces; colour, pattern, and surface texture as selected and indicated.

- D. Pre-finished Panelling: As indicated on drawings.

- E. Wood Particleboard: ANSI A208.1 Type 1 and/or 2; composed of wood chips or sawdust, medium density, made with water resistant adhesive; sanded faces.

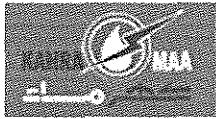
- F. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, standard and/or tempered grade, 6 mm thick, smooth one and/or two sides.

- G. Pegboard: Pressed wood fiber with resin binder, standard and/or tempered grade; 3 mm thick 4 mm diameter holes at 25 mm on centre and/or 6 mm thick with 7 mm diameter holes at 25 mm on centre.

- H. Sheet Metal Components: Stainless steel, Type 316 with #4 satin and/or #8 polished finish.

- I. Synthetic Surfacing: Synthetic marble of polyester and/or proprietary resins, with colour and design as indicated on drawings, stain resistant to domestic chemicals and cleaners.

##### **1.3. ACCESSORIES**



- A. Adhesive for High Pressure Decorative Laminates: FS A-A-1936 contact adhesive and/or Type recommended by laminate manufacturer to suit application.
- B. Fasteners: Of size and type to suit application; galvanized finish in concealed locations and stainless steel type 316 finish in exposed locations.
- C. Concealed Joint Fasteners: Threaded steel.
- D. Lumber for Shimming and Blocking: Softwood lumber as indicated.
- E. Veneer Edge Band: Standard wood veneer edge band matching face veneer.
- F. Plastic Edge Trim: Extruded convex and/or flat shaped; smooth and/or ridged finish; self-locking serrated tongue; of width to match component thickness; colour as selected.
- G. Aluminium Edge Trim: Extruded convex and/or flat shape; smooth and/or ridged surface finish; self-locking serrated tongue; of width to match component thickness; natural mill, clear anodized and/or bronze anodized finish.
- H. Glass: Type as specified in Section 08800.
- I. Float and/or Patterned Glass: ASTM C1036 and/or C1048, type, colour, pattern, quality and thickness as indicated on drawings.
- J. Safety Glass: ASTMC1036 and/or C1048, type, colour, pattern, quality and thickness as indicated on drawings.
- K. Primer: Alkyd primer sealer.
- L. Wood Filler: Solvent and/or Oil base, tinted to match surface finish colour.
- M. Wood Treatment:
  - 1. Fire Retardant (FR-SType): Chemically treated and pressure impregnated; capable of providing maximum flame spread/smoke development rating in accordance with ASTM E84.
  - 2. Wood Preservative by Pressure Treatment (PT Type): AWPA Treatment C1 using water borne preservative with 0.25 lb/cu ft retention.
  - 3. Water Repellant Preservative Treatment by Dipping Method: WDMA I.S.4, with 0.25 cubic lb/in/ft of chromated copper arsenate.
  - 4. Wood Preservative (Surface Application): colour and type as indicated.
  - 5. Shop pressure treat, dip and/or brush apply treatment to wood materials requiring fire rating and/or preservatives to concealed wood blocking.
  - 6. Provide identification on fire retardant treated material.
  - 7. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.
  - 8. Re-dry and/or Kiln dry wood after pressure treatment to maximum moisture content percentage as instructed by the manufacturer.



- N. Hinges: As indicated on drawings.
- O. Pulls: As indicated on drawings.
- P. Latches: As indicated on drawings.
- Q. Shelf Standards: As indicated on drawings.
- R. Shelf Brackets: As indicated on drawings.
- S. Drawer Slides: As indicated on drawings.

#### **1.4. FABRICATION**

- A. Fabricate to AWI Economy, Custom and/or Premium standards and/or WIC Economy, Custom and/or Premium standards.
- B. Shop assembles work for delivery to site, permitting passage through building openings.
- C. Fit exposed sheet material edges with matching hardwood, matching veneer, plastic and/or aluminium edging. Use one piece for full length only.
- D. Cap exposed high pressure decorative laminate finish edges with material of same finish and pattern.
- E. Shop prepare and identify components for book match grain matching during site erection.
- F. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.
- G. Apply high pressure decorative laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 600 mm from sink cut-outs.
- H. Apply laminate backing sheet to reverse face of high pressure decorative laminate finished surfaces.

#### **1.5. SHOP FINISHING**

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.
- D. Finish work in accordance with AWI- Section 1500 Finish System Transparent and/or Opaque.
- E. Finish work in accordance with WIC - Section 25 System (#1) (#2) (#3) (#4) (#5) (#6) (#7) (#8).
- F. Stain, seal, and varnish exposed to view surfaces.
- G. Seal internal surfaces and semi-concealed surfaces.
- H. Prime paint and/or Seal surfaces in contact with cementitious materials.



### 3.4.2.3 PART 3 - EXECUTION

#### 1.6. EXAMINATION

- A. Section 013100 - Administrative Requirements: Coordination and project conditions.
- B. Verify adequacy of backing and support framing.
- C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

#### 1.7. EXISTING WORK

- A. Modify and extend existing finish carpentry installations using materials and methods as specified.

#### 1.8. INSTALLATION

- A. Install work in accordance with AWI, and/or WIC Economy, Custom and/or Premium quality standard.
  - B. Set and secure materials and components in place, plumb and level.
  - C. Carefully scribe work abutting other components, with maximum gaps of 1 mm. Do not use additional overlay trim to conceal larger gaps.
  - D. Install components and/or trim with nails, screws and/or bolts with blind fasteners as instructed by the manufacturer, and/or wall adhesive by gun application.
  - E. Install pre-finished paneling with full bed contact adhesive applied to substrate, and/or nails, screws and/or wall adhesive by bead method as instructed by the manufacturer.
  - F. Install hardware.
  - G. Site Applied Wood Treatment:
    1. Apply preservative treatment.
    2. Brush apply one coat of preservative treatment on wood in contact with cementitious materials, and roofing and related metal flashings. Treat site-sawn cuts.
    3. Allow preservative to dry prior to erecting members.
  - H. Preparation for Site Finishing:
    1. Site Finishing: Refer to Section 099000.
    2. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.
- #### 1.9. ERECTION TOLERANCES
- A. Section 014000 - Quality Requirements: Tolerances.
  - B. Maximum Variation from Indicated Position: 1.5 mm.



- C. Maximum Offset from Alignment with Abutting Materials: 0.7 mm.

#### 1.10. SCHEDULES

- A. As indicated on drawings and where directed by the Engineer.

### **3.4.3 SECTION 06 41 13 - CUSTOM CABINETS**

#### 3.4.3.1 PART 1 - GENERAL

##### 1.1. SUMMARY

- A. Section includes custom-fabricated cabinet units; counter tops; cabinet hardware; preparation for installing utilities in cabinets; and shop and/or site finishing.
- B. Related Sections:
1. Section 062023 - Finish Carpentry: Related trim not specified in this section.
  2. Section 088000 - Glazing: Glass for casework.
  3. Section 099000 - Paints and Coatings: Site finishing of cabinet, exterior and interior.
  4. MEP Specifications: Under-top stainless steel sink, mixers, cabinet, angle valves and all required mechanical installations.

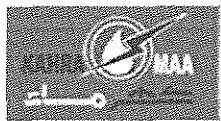
##### 1.2. REFERENCES

- A. Related requirements as referenced:

1. American National Standards Institute:
  - a. ANSI A156.9 - Cabinet Hardware.
  - b. ANSI A208.1 - Mat-Formed Wood Particleboard.
2. Architectural Woodwork Institute:
  - a. AWI - Quality Standards Illustrated.
3. Federal Specification Unit:
  - a. FS A-A-1936 - Adhesive, Contact, Neoprene Rubber.
4. National Electrical Manufacturers Association:
  - a. NEMA LD 3 - High Pressure Decorative Laminates.
5. Woodwork Institute of California:
  - a. WIC - Manual of Millwork.
6. ASTM International:
  - a. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

##### 1.3. SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- C. Product Data: Submit data for hardware accessories.



- D. Samples:
1. Submit two samples, each size 200 x 250 mm illustrating cabinet finish.
  2. Submit two samples each size 200 x 250 mm illustrating counter top finish.
  3. Submit two samples of drawer pulls, hinges, etc. illustrating hardware finish.
- E. Certification: Submit copy of fabricator's authorization to use AWI Grade Stamps, AWI Quality Certification Program license and Project specific letters and/or WIC certified compliance certificate.
- 1.4. QUALITY ASSURANCE**
- A. Perform work in accordance with AWI(Architectural Woodwork Institute) Architectural Woodwork Quality Standards Illustrated, Economy, Custom and/or Premium Grade, and/or WIC (Woodwork Institute of California) Manual of Millwork, Economy, Custom and/or Premium Grade.
- B. Maintain one copy of each document on site.
- 1.5. QUALIFICATIONS**
- A. Fabricator: Company specializing in performing Work of this section with minimum ten years documented experience.
- 1.6. MOCKUP**
- A. Section 014000 - Quality Requirements: Mockup requirements.
- B. Construct mockup of full size base cabinet and upper cabinet including plumbing and electrical fixtures, hardware, accessories and fitments.
- C. Locate where directed by the Engineer.
- D. Remove mockup when directed by the Engineer.
- 1.7. PRE-INSTALLATION MEETINGS**
- A. Section 013100 - Administrative Requirements: Pre-installation meeting. B. Convene minimum one week prior to commencing work of this section.
- 1.8. DELIVERY, STORAGE, AND HANDLING**
- A. Section 016000 - Product Requirements: Product storage and handling requirements. B. Protect units from moisture damage.
- 1.9. ENVIRONMENTAL REQUIREMENTS**
- A. Section 016000 - Product Requirements.
- B. During and after installation of Work of this section, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.
- 1.10. FIELD MEASUREMENTS**
- A. Verify field measurements prior to fabrication.
- 1.11. WARRANTY**
- A. Section 017700 – Close out submittals for additional warranty requirements.



### 3.4.3.2 PART 2 - PRODUCTS

#### 1.1. CUSTOM CABINETS

- A. Manufacturer: Any locally available and recognized manufacturer having an official technical data and approved description in conformity with standards for the product herein.

#### 1.2. COMPONENTS

- A. Softwood and/or Hardwood Lumber: AWIGrade III, I and/or I; and/or WICEconomy, Custom and/or Premium Grade; maximum moisture content of 6-8 percent;
- B. Softwood and/or Hardwood Plywood: AWIGrade B, A and/or AA veneer; and/or WIC Economy, Custom and/or Premium veneer; with particleboard, medium density fiberboard, veneer and/or lumber core; type of glue recommended for application;
- C. Wood Particleboard: ANSI A208.1 Type 1 and/or 2; composed of wood chips or sawdust, medium density, made with water resistant adhesive; sanded faces.
- D. High Pressure Decorative Laminate: NEMALD3, GP50 for horizontal surfaces, GP28 for vertical surfaces, CL20 for cabinet liner surfaces, BK20 for undecorated backing sheets, PF42 for post forming, and/or FR50 for fire-retardant surfaces; Colour, pattern, and surface texture as selected and/or indicated on drawings.
- E. Sheet Metal Components: Stainless steel, Type 316 with #4 satin and/or #8 polished finish;
- F. Synthetic Surfacing: Synthetic marble of polyester and/or proprietary resins, stain resistant to domestic chemicals and cleaners and as per approved codes and standards.
- G. Counter Tops, Back Splash and Side Splash: As per schedule stated hereinafter or as shown on drawings.
- H. Service Fittings for Kitchen Cupboards: As per schedule stated hereinafter or as shown on drawings.
- I. Electrical Built-in Appliances in Kitchen Cupboards: As per schedule stated hereinafter or as shown on drawings.

#### 1.3. ACCESSORIES

- A. Adhesive for High Pressure Decorative Laminates: FSA-A-1936 contact adhesive. Type recommended by laminate manufacturer to suit application.
- B. Veneer Edge Band: Standard wood veneer edge band matching face veneer.
- C. Plastic Edge Trim: Extruded convex and/or flat shaped; smooth and/or ridged finish; self-locking serrated tongue; of width to match component thickness; colour as selected and/or as indicated on drawings.
- D. Aluminium Edge Trim: Extruded convex and/or flat shape; smooth and/or ridged surface finish; self-locking serrated tongue; of width to match component thickness; natural mill, clear anodized and/or bronze anodized finish.
- E. Glass: As specified in Section 088000.
- F. Fasteners: Size and type to suit application.



- G. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized finish in concealed locations and stainless steel type 316 finish in exposed locations.
- H. Bolts: Steel and comply with BS916
- I. Washers: to BS3410, part 2.
- J. Screws:
  1. All steel screws shall be finished to resist corrosion by sherardizing, cadmium plating, nickel plating or other approved finish.
  2. Screws shall be protected steel, stainless steel type 316, brass silicone bronze, nickel/copper alloy or aluminium as specified on drawings or as appropriate to the work. Screws for fixing hardware shall match the items being fixed.
  3. Screw heads shall be for the generality of the work, countersunk slotted. Screw heads in the finished work shall, unless otherwise described, be brass, bronzed finish with matching fully countersunk brass cups. Phillips crosshead screws or pozidrive screws shall be used where so described on drawings.
- I. Concealed Joint Fasteners: Threaded steel.
- J. Grommets: Plastic, Metal and/or Rubber material for cut-outs.
- K. Hardware:
  7. Hinges: Plain bearing two knuckle stainless steel type 316 hinges (3 No. per door leaf).
  8. Knob for door panels as selected (1 No. per door leaf).
  9. Perforations: 25mm diameter to act instead of knobs where indicated.
  10. Lock: Cabinet lock for each door panel or couple of panels as appropriate with security cylinder and with two keys for each lock.
  11. Knob for drawer as selected (1 No. per drawer).
  12. Drawer runners: Steel telescopic runners (full width of drawer on both sides).
  13. Chrome pins for adjustable shelves.
  14. Chrome hanging rods.
- L. Shelf Standards and Rests: Formed steel channels and rests, cut for fitted rests spaced as indicated; chrome and/or satin finish.
- M. Shelf Brackets: Formed steel brackets, formed for attachment with lugs; chrome and/or satin finish.
- N. Drawer and Door Pulls: Extruded aluminium pull, full width of drawer, polished and/or satin finish, "U" shaped pull, steel with chrome and/or satin finish, aluminium with polished and/or satin finish, bronze with satin finish, and/or plastic of colour as selected.
- O. Sliding Door Pulls: Circular, Oval and/or Elongated shape, steel with chrome and/or satin finish, aluminium with polished and/or satin finish, bronze with satin finish, and/or plastic of colour as selected.
- P. Catches: Type as indicated on drawings.
- Q. Drawer Slides: Galvanized steel construction, ball bearings separating tracks, full extension type.
- R. Sliding Door Track Assemblies: Galvanized steel construction, ball bearing carriers fitted within tracks, multiple pendant suspension attachments for door.



#### 1.4. FABRICATION

- A. Shop assembles casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Fit shelves, doors, and exposed edges with matching veneer, plastic and/or aluminium edging. Use one piece for full length only.
- C. Cap exposed high pressure decorative laminate finish edges with material of same finish and pattern.
- D. Door and Drawer Fronts: 19 mm thick; flush, overlay and/or reveal overlay style.
- E. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.
- F. Apply high pressure decorative laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 600 mm from sink cut-outs.
- G. Apply wood laminate by grain matching adjacent sheets to book, slip, random and/or end matching.
- H. Apply laminate backing sheet to reverse side of plastic and/or wood laminate finished surfaces.
- I. Fabricate metal counter top surfaces pressure glued to plywood or particle board core backing with butt or welded joints, or without visible joints.
- J. Mechanically fasten back splash to counter tops with steel brackets at 400 mm on center.
- K. Fabricate cabinets and counter tops with cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Prime paint and/or Seal cut edges.
- L. Shop glaze glass materials using Interior Dry, Combination and/or Wet method specified in Section 088000.

#### 1.5. SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.
- D. Finish work in accordance with AWI- Section 1500 Finish System Transparent and/or Opaque.
- E. Finish work in accordance with WIC - Section 25 System (#1) (#2) (#3) (#4) (#5) (#6) (#7) (#8).
- F. Stain, seal and varnish exposed to view surfaces. Brush and/or Spray apply only.
- G. Seal and/or stain and varnish internal exposed to view and semi-concealed surfaces.
- H. Seal internal surfaces of cabinets.
- I. Prime paint and/or Seal surfaces in contact with cementitious materials. J. Finish in accordance with Section 099000.

#### 3.4.3.3 PART 3 - EXECUTION

##### 1.1. EXAMINATION



- A. Section 013100 - Administrative Requirements: Coordination and project conditions.

- B. Verify adequacy of backing and support framing.

- C. Verify location and sizes of utility rough-in associated with work of this section.

#### 1.2. INSTALLATION

- A. Set and secure casework in place; rigid, plumb and level.

- B. Use fixture attachments in concealed locations for wall mounted components.

- C. Use concealed joint fasteners to align and secure adjoining cabinet units, counter tops etc.

- D. Carefully scribe casework abutting other components, with maximum gaps of 1 mm. Do not use additional overlay trim for this purpose.

- E. Secure cabinet and counter bases to floor using appropriate angles and anchorages.

- F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

- G. Site glaze glass materials using Interior Dry, Combination or Wet method specified in Section 088000.

#### 1.3. ADJUSTING

- A. Section 017300 - Execution Requirements: Testing, adjusting and balancing.

- B. Adjust moving or operating parts to function smoothly and correctly.

#### 3.4 CLEANING

- A. Section 017300 - Execution Requirements: Final cleaning.

- B. Clean casework, counters, shelves, hardware, fittings and fixtures.

#### 1.4. SCHEDULES

- A. As indicated on detailed drawings for kitchen cabinet and where directed by the Engineer. Refer to BOQ for Proper description for the structure of cabinets and components.

### **3.4.4 SECTION 06 48 00 - WOOD FRAMES**

#### **3.4.4.1 PART 1 – GENERAL**

##### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2. SUMMARY**

- A. Section Includes:

- 1. Exterior frames and jambs.



2. Interior frames and jambs.
3. Shop priming wood frames and jambs.
4. Shop finishing wood frames and jambs.

#### **1.3. ACTION SUBMITTALS**

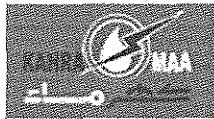
- A. Product Data: For each type of product, including fire-retardant-treated materials and finishing materials and processes. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  1. Show details full size.
  2. Show locations and sizes of concealed blocking and reinforcement specified in other Sections.
  3. Apply WI Certified Compliance Program label to Shop Drawings.
  4. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples for Initial Selection:
  1. Shop-applied transparent finishes.
  2. Shop-applied opaque finishes.
- D. Samples for Verification:
  1. Lumber for transparent finish, not less than 125 mm wide by 300 mm long, for each species and cut, finished on one side and one edge.
  2. Lumber with shop-applied opaque finish, 125 mm wide by 300 mm long for, for each finish system and colour, with one-half of exposed surface finished.

#### **1.4. INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and fabricator.
- B. Product Certificates: For each type of product and adhesives.
- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates or WI Certified Compliance Program certificates.
- D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

#### **1.5. QUALITY ASSURANCE**

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program, or Shop is a licensee of WI's Certified Compliance Program.



- B. Installer Qualifications: Fabricator of products and certified participant in AWI's Quality Certification Program.
  - C. Testing Agency Qualifications: For testing agency providing classification marking for fire- retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
  - D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
    - 1. Build mockups of typical wood frames as shown on Drawings.
    - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.6. **DELIVERY, STORAGE, AND HANDLING**
- A. Do not deliver wood frames until operations that could damage wood frames have been completed in installation areas. If wood frames must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- 1.7. **FIELD CONDITIONS**
- A. Weather Limitations for Exterior Work: Proceed with installation of exterior wood frames only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.
  - B. Environmental Limitations for Interior Work: Do not deliver or install interior wood frames until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
  - C. Environmental Limitations for Interior Work: Do not deliver or install interior wood frames until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 16 and 32 deg C and relative humidity between 25 and 55 43 and 70 percent during the remainder of the construction period.
  - D. Field Measurements: Where wood frames are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction Progress to avoid delaying the Work.
    - 1. Locate concealed framing, blocking, and reinforcements that support wood frames by field measurements before being enclosed, and indicate measurements on Shop Drawings.



E. Established Dimensions: Where wood frames are indicated to fit to other construction, establish dimensions for areas where wood frames are to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

**1.8. COORDINATION**

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood frames can be supported and installed as indicated.

**1.9. WARRANTY**

A. Section 017700 – Close out submittals for additional warranty requirements.

**3.4.4.2 PART 2 ~ PRODUCTS**

**1.1. WOOD FRAME FABRICATORS**

A. Manufacturer: Any locally available and recognized manufacturer having an official technical data and approved description in conformity with standards for the product herein.

**1.2. WOOD FRAMES, GENERAL**

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood frames indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI or WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard. Type of wood to be used in manufacturing the doors, frames, sub frames and cabinets is African teak wood. Sample of wood required for Engineer's approval.

**1.3. EXTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH**

A. Grade: Premium.

B. Regional Materials: Exterior frames and jambs for transparent finish shall be manufactured within 800 km of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 800 km of Project site.

C. Certified Wood: Exterior frames and jambs for transparent finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

D. Wood Species: African Teak wood or Approved Equal

**1.4. EXTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH**



- A. Grade: Premium.
- B. Regional Materials: Exterior frames and jambs for opaque finish shall be manufactured within 800 km of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 800 km of Project site.

- C. Certified Wood: Exterior frames and jambs for opaque finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- D. Wood Species: African teak wood or approved equal.

#### **1.5. INTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH**

- A. Grade: Premium.
- B. Regional Materials: Interior frames and jambs for transparent finish shall be manufactured within 800 km of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 800 km of Project site.

- C. Regional Materials: Interior frames and jambs for transparent finish shall be manufactured within 800 km of Project site.
- D. Certified Wood: Interior frames and jambs for transparent finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

- E. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.

- 1. Species: African Teak wood or approved equal.
- 2. Cut: Quarter cut/quarter sawn.
- 3. Provide split species on frames and jambs that face areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

- F. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.
- G. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant medium-density fiberboard with veneered exposed surfaces and listed and labelled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

- 1. Fire Rating: 20 minutes.

#### **1.6. INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH**

- A. Grade: Premium.



- B. Regional Materials: Interior frames and jambs for opaque finish shall be manufactured within 800 km of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 800 km of Project site.
- C. Regional Materials: Interior frames and jambs for opaque finish shall be manufactured within 800 km of Project site.
- D. Certified Wood: Interior frames and jambs for opaque finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Wood Species: African Teak wood or approved equal.
- F. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard with veneered exposed surfaces or fire-retardant medium-density fiberboard and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
  - 1. Fire Rating: 20 minutes.

#### 1.7. WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood frame and quality grade specified unless otherwise indicated.
  - 1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 75 mm wide.
  - 2. Wood Moisture Content for Exterior Materials: 10 to 15%.
  - 3. Wood Moisture Content for Interior Materials: 8 to 13%.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of wood frame and quality grade specified unless otherwise indicated.
  - 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than percent.
  - 2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements.
  - 3. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
  - 4. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
  - 5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
    - a. Products: Subject to compliance with requirements, locally approved available products that may be incorporated into the Work.



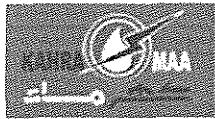
- C. Water-Repellent Preservative Treated Materials: Comply with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment) for exterior wood frames indicated to receive water-repellent preservative treatment.
1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with an insecticide containing chloropyrifos (CPF).
  2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
  3. Extent of Water-Repellent Preservative Treatment: Treat all exterior wood frames unless otherwise indicated.
  4. Items fabricated from the following wood species need not be treated:
    - a. All-heart redwood.
    - b. All-heart western red cedar.
    - c. White oak.
    - d. African mahogany.
    - e. Honduras mahogany.
    - f. Ipe.
    - g. Dark red meranti.
    - h. African Teak Wood.

#### 1.8. FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
1. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 3.2 m beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.



- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
    - 1. For panels 19 mm thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 11 MPa; modulus of elasticity, 2070 MPa; internal bond, 550 kPa; and screw-holding capacity on face and edge, 1100 and 1000 N, respectively.
    - 2. Products: Subject to compliance with requirements, locally approved available products that may be incorporated into the Work include, but are not limited.
  - D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTME 84.
    - 1. Products: Subject to compliance with requirements, locally approved available products that may be incorporated into the Work.
- 1.9. MISCELLANEOUS MATERIALS
- A. Exterior Blocking, Shims, and Nailers: Softwood or hardwood lumber, pressure-preservative treated, kiln dried to less than 15% moisture content.
    - 1. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b.
      - a. Kiln dry lumber after treatment to a maximum moisture content of 19%.
      - b. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
      - c. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.
  - B. Interior Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln dried to less than 15% moisture content.
  - C. Nails for Exterior Use: hot-dip galvanized or stainless steel.
  - D. Screws for Exterior Use: hot-dip galvanized or stainless steel.
  - E. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
  - F. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
  - G. Adhesives: Do not use adhesives that contain urea formaldehyde.



- H. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**1.10. FABRICATION**

- A. Fabricate wood frames to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
1. Edges of Solid-Wood (Lumber) Members: 1.5 mm unless otherwise indicated.

**1.11. SHOP PRIMING**

- A. Exterior Wood Frames for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099000 "Paint and Coating."
- B. Exterior Wood Frames for Transparent Finish: Shop seal with stain (if required), other required pre-treatments, and first coat of finish as specified in 099000 "Paint and Coating."
- C. Interior Wood Frames for Opaque Finish: Shop prime with one coat of wood primer specified in 099000 "Paint and Coating."
- D. Interior Wood Frames for Transparent Finish: Shop seal with stain (if required), other required pre-treatments, and first coat of finish as specified in 099000 "Paint and Coating."
- E. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.
1. Back-priming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

**1.12. SHOP FINISHING**

- A. General: Finish wood frames at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. General: Shop finish transparent-finished wood frames at fabrication shop as specified in this Section. 099000 "Paint and Coating."
- C. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to 099000 "Paint and Coating." for field finishing wood frames not indicated to be shop finished.
- D. Finish Materials: Use finish materials that meet the testing and product requirements and approved by the Engineer.



- E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.
  - 1. Back-priming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood frames. Apply two coats to end-grain surfaces.
- F. Transparent Finish for Exterior Frames: Comply with 099000 "Paint and Coating."
- G. Opaque Finish for Exterior Frames: Comply with 099000 "Paint and Coating."
- H. Transparent Finish for Interior Frames:
  - 1. Grade: Premium.
  - 2. Finish: System - 1, nitrocellulose lacquer.
  - 3. Finish: System - 2, pre-catalyzed lacquer.
  - 4. Finish: System - 3, post-catalyzed lacquer.
  - 5. Finish: System - 4, water-based latex acrylic.
  - 6. Finish: System - 5, conversion varnish.
  - 7. Finish: System - 6, synthetic penetrating oil.
  - 8. Finish: System - 7, catalyzed vinyl.
  - 9. Finish: System - 8, water-based cross linking acrylic.
  - 10. Finish: System - 9, UV curable acrylated epoxy, polyester, or urethane.
  - 11. Finish: System - 10, water-based UV curable.
  - 12. Finish: System - 11, catalyzed polyurethane.
  - 13. Finish: System - 12, water-based polyurethane.
  - 14. Finish: System - 13, catalyzed polyester.
  - 15. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
  - 16. Staining: Match Architect's sample.
  - 17. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
  - 18. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
  - 19. Sheen: Semi-gloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523.
- I. Opaque Finish for Interior Frames:
  - 1. Grade: Premium.
  - 2. Finish: System - 1, nitrocellulose lacquer.
  - 3. Finish: System - 2, pre-catalyzed lacquer.
  - 4. Finish: System - 3, post-catalyzed lacquer.
  - 5. Finish: System - 4, water-based latex acrylic.



6. Finish: System - 5, conversion varnish.
7. Finish: System - 7, catalyzed vinyl.
8. Finish: System - 8, water-based cross linking acrylic.
9. Finish: System - 9, UV curable acrylated epoxy, polyester, or urethane.
10. Finish: System - 10, water-based UV curable.
11. Finish: System - 11, catalyzed polyurethane.
12. Finish: System - 12, water-based polyurethane.
13. Finish: System - 13, catalyzed polyester.
14. Colour: As indicated by manufacturer's designations.
15. Sheen: Semi-gloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523.

#### **3.4.4.3 PART 3 – EXECUTION**

##### **1.1. PREPARATION**

- A. Before installation, condition wood frames to average prevailing humidity conditions in installation areas.
- B. Before installing wood frames, examine shop-fabricated work for completion and complete work as required, including removal of packing and back priming.

##### **1.2. INSTALLATION**

- A. Grade: Install wood frames to comply with same grade as item to be installed.
- B. Assemble wood frames and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install wood frames level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 3 mm in 2400 mm.
- D. Scribe and cut wood frames to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor wood frames to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
  - a. For shop-finished items, use filler matching finish of items being installed.



- G. Touch up finishing work specified in this Section after installation of wood frames. Fill nail holes with matching filler where exposed.
    - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.
  - H. Refer to 099000 "Paint and Coating" for final finishing of installed wood frames.
- 1.3. **ADJUSTING AND CLEANING**
- A. Repair damaged and defective wood frames, where possible, to eliminate functional and visual defects; where not possible to repair, replace wood frames. Adjust joinery for uniform appearance.
  - B. Clean wood frames on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

### **3.5 DIVISION 07 THERMAL & MOISTURE PROTECTION**

#### **3.5.1 SECTION 07 11 13 – BITUMINOUS DAMPROOFING**

##### **3.5.1.1 PART 1 - GENERAL**

###### **1.1. SECTION INCLUDES**

- A. This section includes, but is not limited to, the following work.
  - 1. Supply and installation of waterproofing membranes over concrete mud (skim) slab (blinding concrete) on grade; on exterior face of basement foundation walls, pit and trench walls; over caisson/pile caps; on interior of planters; and over concrete slabs under paving; and as specified herein.
- B. Supply necessary materials and install completely monolithic waterproofed envelope system to entire foundation and lowest under-slab locations. System shall be a completely tanked application with protection board and necessary flashings and components to ensure a watertight basement. Under-slab horizontal membrane is laid over concrete mud slab (blinding concrete).

###### **1.2. RELATED SECTIONS**

- A. Civil & Structural Specifications - Surface Preparation.

###### **1.3. REFERENCES**

- A. Related requirements as referenced:

- 1. UAEtc Special Directives for the Assessment of SBS Elastomer bitumen MOAT 31, 84.
- 2. BS 8102:1990 Code of Practice for Protection of Structures against water from the ground.

###### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Samples:



1. Submit 300mm long samples of flashing reglets.
2. Submit 300mm x 300mm samples of membrane.
3. Submit 300mm x 300mm samples of protection board or protection material.

#### **1.5. QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Install waterproofing system specified in this section only by a firm who has adequate plant, equipment, and skilled tradesmen to perform it expeditiously, and is known to have been responsible for satisfactory applications similar to that specified for a period of at least the immediate past five years.
- B. Applicator Qualifications: Apply waterproofing only by an applicator approved by the manufacturer of the membrane material.

#### **1.6. DELIVERY, STORAGE, AND PROTECTION**

- A. Package waterproofing materials and identify on attached labels the manufacturer, contents and material specification number.

#### **1.7. SITE CONDITIONS**

##### **A. Environmental Conditions**

1. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site, and cause no damage to the products specified in this section or to the performance of these products in use.
2. Follow recommendations of the supplier of the products.
3. Environmental conditions shall include, but shall not be limited to, ambient temperature; humidity; moisture in the air and on the products and surfaces with which they are in contact; moisture content and temperature of the products and the materials with which they are in contact.

#### **1.8. GUARANTEE**

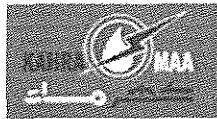
- A. Include waterproofing material and installation under 10 (ten) years guarantee for waterproofing AS specified in Conditions of Contract.

#### **3.5.1.2 PART 2 - PRODUCTS**

##### **1.1. MATERIALS**

- A. Membrane below Grade Tanking: 1 No. layer of 4mm thick SBS elastomeric bitumen membrane, with 180g non-woven spun bonded polyester reinforcement, compound elongation properties 1000%, Torch applied.

1. Manufacturers, or equal approved:



- a. TERANAP 431 TP from SIPLAST, Siplast G.C.C Branch, P.O.Box 43821, Abu Dhabi, U.A.E.,
  - b. CINTAFLEX 3000 from Smid and Hollander distributed by ESHA Middle East (LLC), P.O. Box 6589, Dubai, U.A.E.,
  - c. FORCE 4000 PY from Axter, Distributed by Beam Engineering, Sharjah.
2. Substitutions: See Section 016000 - Product Requirements
- B. Primer as recommended by Manufacturer for substrates.
  - C. Joint Sealant as recommended by Manufacturer of Membrane.
  - D. Bond Breaker: over mud slab (blinding concrete) as recommended by Membrane Manufacturer.
  - E. Bond Breaker: over joints: A rubber membrane or wax emulsion of width and thickness to suit joint width, compatible with membrane material and as recommended and supplied by waterproofing membrane manufacturer.
  - F. Joint Reinforcement:
    - 1. As recommended by Membrane Manufacturer or
    - 2. Platon (Vertically) from Siplast prefabricated embossed HDPE drainage/protection or
    - 3. Texmastic Backer Board 501A.
    - 4. Servipak by Servicised Ltd. (Horizontally only) or screed on 700g geotextile
  - G. Membrane Reglets: As recommended by Membrane Manufacturer.
  - H. Water Stops: Extruded from high grade PVC, web section, with central fin, nailing flange with reinforced edge 250mm width.
    - 1. Rearguard 'R' by: Al Gurg/Fosroc, P.O. BOX 657, Dubai, U.A.E., Tel: 04 2858606
    - 2. Serviseal HD240 by: Servicised Limited, Ajax Ave, Slough, Berkshire, SLI 4BH U.K., Tel: 0753 692929, Fax: 0753 691623
    - 3. or Approved equal.
  - I. Protection Board: Bitumen impregnated protection board compatible with membrane material to protect membrane during damages during backfilling.
  - J. Shop drawings showing water-bar layout with all waterproofing details to be provided. All junctions to be prefabricated factory made from manufacturers standard range of junctions.

### 3.5.1.3 PART 3 - EXECUTION

#### 1.2. EXAMINATION

- A. Ensure that surfaces to receive membrane are smooth, firm, dry and free of moisture, voids, projections, loose material, oil, grease, asphalt, curing compounds and other foreign matter.



- B. Ensure that vertical applications of membrane terminate in reglets.
- C. Defective waterproofing installation resulting from application to unsatisfactory surfaces will be considered the responsibility of those installing the waterproofing specified in this section, and shall be removed and reapplied.

#### **1.3. PREPARATION**

- A. Membrane Reglets: Supply, locate and assist, if requested, in the installation of flashing reglets in concrete for receiving membrane.
- B. Prior to and during application, remove all dust and dirt from substrate surfaces, using an industrial type vacuum cleaner or by blowing clean with an air compressor.
- C. Take particular care to prevent staining of adjacent property, construction and surfaces by waterproofing materials. Replace porous materials that cannot be completely removed.

#### **1.4. APPLICATION**

##### **A. General**

1. Apply waterproofing materials to meet specified requirements of membrane manufacturer. The two layer system (where applicable) shall be applied so that all surfaces shall have continuous layer of 4mm membrane.
2. Application to the following surfaces will be in the scope of this work: tie beams, neck columns, below ground slabs and walls, pile caps.
3. Supervise all application operations by a competent foreman, that all surface areas are adequately covered, that junctions with other materials or constructions ensure watertight conditions, and that membrane terminations are sealed watertight, all to ensure a complete waterproof system for areas indicated on drawings.
4. Turn membrane up a minimum of 150mm above plane of waterproofing at junctions with vertical surfaces, or as far as practicable to maintain a concealed installation unless indicated otherwise on drawings.
5. Carry membrane up tie beams and horizontally on top of beams only to extent indicated on drawings and to achieve complete bonding.
6. Make watertight all junctions with services or other elements that penetrate the waterproofing membrane. Coordinate installation of waterproofing with those who install such penetrations.

##### **B. Bond Breaker at Mud Slab (Blinding Concrete)**

1. Install bond breaker membrane dry over mud slab with joints lapped as per Manufacturer's recommendations.

##### **C. Primer**



1. Except where bond breaker is installed on mud slab, apply primer to waterproofed surfaces by fine spray, or with roller or brush, at approximate rate of 0.2 liter per square meter as determined by condition of concrete and to provide suitable base for membrane application.
- D. Cracks and Joints
  1. Clean, install back up rods where width of joint requires, and caulks all cracks and joints in substrate, and between differing substrate materials, with heated and poured-in joint sealant.
  2. Apply suitable bond breaker over joints.
- E. Junctions of Horizontal and Vertical Surfaces
  1. Apply the first ply of membrane at junctions, to extend vertically 150mm minimum and horizontally 200mm minimum. The vertical part of the membrane shall be lapped over a sand/cement fillet and then be fully torched to the vertical substrate.
  2. Install membrane material at junctions minimum 300mm wide.
  3. Apply main membrane over 300mm membrane strip at junctions and substrate joints.
  4. All laps 100mm wide longitudinal and transversal shall be fully torched.
- 1.5. LEANING
- A. Remove all debris and soil caused from waterproofing operations from other areas and surfaces.
- 1.6. PROTECTION
- A. Before Final Backfilling: Where areas are in full contact with soil and prior to backfilling operations protection boards shall be installed to prevent displacement. Protection boards shall be butt jointed and taped.
- B. At the final backfilling: Ensure that no other materials are applied to waterproofing membranes incompatible with membrane material. Protection board to be applied only after membrane has been cleared of debris. Butt joint and tape boards as above.
- C. The foundations shall be backfilled with soil immediately after the installation of the waterproofing system and the protection boards, subject to the Engineer approval.

### **3.5.2 SECTION 07 13 54 - THERMOPLASTIC SHEET WATERPROOFING**

#### **3.5.2.1 PART 1 - GENERAL**

##### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2. SUMMARY**

- A. Section includes PVC sheet waterproofing for horizontal installations.



B. Related Requirements:

1. Section 071113 "Bituminous Damp proofing"

1.3. PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Site.

1. Review waterproofing requirements including surface preparation, substrate condition and pre-treatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.4. SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include layout drawings showing locations of sub-membrane containment strips and control test drains.
2. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For each exposed product and for each colour and texture specified, including the following products:

1. 200-by-200-mm square of waterproofing and flashing sheet.
2. 200-by-200-mm square of insulation.
3. 100-by-100-mm square of drainage panel.
4. Plaza-deck paver, 100-by-100-mm square or full sized, in each colour and texture required.
5. Paver pedestal assembly.

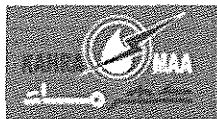
1.5. INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.6. QUALITY ASSURANCE



- A. **Installer Qualifications:** An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- B. **Mockups:** Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
  - 1. Build for each typical waterproofing installation including pavers and accessories to demonstrate surface preparation, crack and joint treatment, corner treatment, and protection.
    - a. Size: 9.3 sq. m in area or as shown on Drawings.
    - b. Description: Each type of deck and plaza installation.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless the Engineer specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7. FIELD CONDITIONS

- A. **Environmental Limitations:** Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
  - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Do not permit asphaltic materials or polystyrene insulation to contact PVC materials.
- C. Maintain adequate ventilation during preparation and application of waterproofing materials.

#### 1.8. WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer's standard warranty in which manufacturer agrees to repair and replace waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
  - 1. **Warranty Period:** 10 years from date of Substantial Completion.
- B. **Installer's Special Warranty:** Specified form, on warranty form at end of this Section, signed by Installer, covering Work of this Section, for warranty period of two years.
  - 1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

#### 3.5.2.2 PART 2 - PRODUCTS

##### 1.1. MATERIALS, GENERAL

- A. **Source Limitations for Waterproofing System:** Obtain waterproofing materials, protection course, and moulded-sheet drainage panels from single source from single manufacturer.

##### 1.2. PVC SHEET WATERPROOFING



- A. Available-Manufacturer-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product based on the list of manufacturers as approved by the Engineer:
- B. PVC Sheet: 2.4-mm- thick, PVC membrane with integral pigments, stabilizers, UV absorbers, biocide, and non-woven fiberglass reinforcement; with the following properties measured according to standard test methods referenced:
  1. Tensile Strength: 10.3 MPa minimum; ASTM D 638.
  2. Elongation at Break: 240 percent minimum, machine direction; ASTM D 638.
  3. Seam Strength: 90 percent minimum of tensile strength; ASTM D 638.
  4. Retention of Properties after Heat Aging: 95 percent minimum retention of tensile strength and elongation; ASTM D 638 after 168 hours at 90 deg C; ASTM D 3045.
  5. Tear Resistance: 95 N minimum; ASTM D 1004.
  6. Low-Temperature Bend: Pass at minus 40 deg C; ASTM D 2136.
  7. Linear Dimension Change: 0.002 percent maximum after 6 hours at 80 deg C; ASTM D 1204.
  8. Water Absorption: 2.5 percent maximum weight gain after 168 hours' immersion at 70 deg C; ASTM D 570.
  9. Dynamic Puncture Resistance: 5 J minimum; ASTM D 5635.
- C. Self-Adhered PVC Sheet: 3.0-mm- thick, composite sheet composed of 1.5-mm- thick, PVC membrane with integral pigments, stabilizers, biocide, and non-woven fiberglass reinforcement; a 1.5 mm thick, non-permeable, closed-cell-foam backing layer; and a pressure-sensitive adhesive coating; with the following properties measured according to standard test methods referenced:
  1. Tensile Strength: 10.3 MPa minimum; ASTM D 638.
  2. Elongation at Break: 240% minimum, machine direction; ASTM D 638.
  3. Seam Strength: 90 percent minimum of tensile strength; ASTM D 638.
  4. Retention of Properties after Heat Aging: 95% minimum retention of tensile strength and elongation; ASTM D 638 after 168 hours at 90 deg C; ASTM D 3045.
  5. Tear Resistance: 95 N minimum; ASTM D 1004.
  6. Linear Dimension Change: 0.002%maximum after 6 hours at 80 deg C; ASTM D 1204.
  7. Dynamic Puncture Resistance: 40 J minimum; ASTM D 5635.

### 1.3. AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
  1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.



- B. Concealed Sheet Flashing: Same material, construction, and thickness as sheet waterproofing.
- C. Exposed Sheet Flashing: PVC-sheet flashing 2.4 mm thick; PVC with integral pigments, stabilizers, UV absorbers, and biocide; reinforced with non-woven fiberglass.
- D. Surface Conditioner: Manufacturer's standard waterborne surface treatment to bind residual surface dust and efflorescence to substrate.
- E. Bonding Adhesives: For bonding waterproofing sheets, containment strips, and PVC-sheet flashings to substrates.
- F. Containment Strip: Manufacturer's standard asphalt-resistant, 1.5-mm-thick, PVC strip; reinforced with non-woven fiberglass; 300 mm wide.
- G. Geo-textile Levelling Layer: Manufacturer's standard 5.59-mm-thick, non-woven polypropylene fabric.
- H. Separation Layer: Manufacturer's standard 4.06-mm-thick, non-woven polypropylene fabric.
- I. Protection Course: 1.0-mm-thick, HDPE sheet or 1.3-mm-thick, hot-air-weldable, PVC sheet protection layer.
- J. Waterproofing and Sheet-Flashing Accessories: Provide sealants, pourable sealers, termination reglets, clamps, compression bars, tapes, preformed cone and stack flashings, and other accessories recommended by waterproofing manufacturer for intended use.
- K. Control Test Drain: Manufacturer's standard assembly to verify the absence or presence of leaks from underside of waterproofed slab.
- L. Metal Termination Bars: Manufacturer's standard stainless-steel or aluminum bars, pre-punched, with non-corrosive fasteners.

#### **1.4. MOULDED-SHEET DRAINAGE PANELS**

- A. Woven-Geo-textile-Faced, Moulded-Sheet Drainage Panel: Composite subsurface drainage panels consisting of a studded, non-biodegradable, moulded-plastic-sheet drainage core; with a woven-geo-textile facing with an apparent opening size not exceeding 0.425-mm sieve laminated to one side of the core; and with a horizontal flow rate not less than 35 L/min. per m.
  - 1. Available-Manufacturer-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product based on the list of manufacturers as approved by the Engineer.

#### **1.5. INSULATION**

- A. Insulation, General: Comply with Section 072100 "Thermal Insulation."
- B. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578.
  - 1. Type IV, 173-kPa minimum compressive strength.
  - 2. Type VI, 276-kPam minimum compressive strength.



3. Type VII, 414-kPa minimum compressive strength.
4. Type V, 690-kPa minimum compressive strength.

### **3.5.2.3 PART 3 - EXECUTION**

#### **1.1. EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
  1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
  2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **1.2. SURFACE PREPARATION**

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Prepare, treat, and seal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

#### **1.3. FULLY ADHERED SHEET INSTALLATION**

- A. General: Install self-adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions.
  1. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
  2. Install laps shingled with slope of deck where possible.
  3. Install flashings concurrently with deck sheet.
  4. Perform hot-air welding to ensure a watertight seam installation. Inspect outside edge of seams with pointed metal probe and ensure completed laps lay flat and are free of voids, fishmouths, or wrinkles.



5. Install temporary cut-offs if work is interrupted. Remove the cut-offs completely before proceeding with the installation.
6. Install sheets and auxiliary materials to tie into adjoining waterproofing.
- B. Apply surface conditioner, at required rate, to substrates to receive waterproofing. Apply only at temperatures greater than minus 4 deg C and rising.
- C. Apply and firmly adhere sheets to substrate; butt adjoining sheets tightly. Apply only when the membrane, air, and substrate temperatures are greater than 5 deg C and rising. Apply a minimum 203-mm- wide cover strip centered over joints and lap edges; hot-air weld cover strip to deck sheet.
- D. Hot-air weld three-way overlaps or T-joints with a 102-mm- round or -square patch.
- E. Unless terminations and deck-sheet waterproofing perimeter are sealed with flashings, secure them with mechanically anchored metal termination bar. Seal edge of termination with sealant.
- F. Install flashing at deck drains. Spread sealant bed over deck drain flange, lap flashing membrane into drain flange and over deck sheet according to membrane manufacturer's written instructions, and hot-air-weld flashing to deck sheet; securely seal flashing sheet in place with clamping ring.
- G. Perform field quality-control flood testing before subsequent work.
- H. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

#### **1.4. LOOSELY LAID SHEET INSTALLATION**

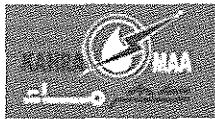
- A. General: Install loosely laid sheets over entire area to receive waterproofing according to manufacturer's written instructions.
  1. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
  2. Install laps shingled with slope of deck where possible.
  3. Install flashings concurrently with deck sheet.
  4. Perform hot-air welding to ensure a watertight seam installation. Inspect outside edge of seams with pointed metal probe and ensure completed laps lay flat and are free of voids, fishmouths, or wrinkles.
  5. Install temporary cut-offs if work is interrupted. Remove the cut-offs completely before proceeding with the installation.
  6. Install sheets and auxiliary materials to tie into adjoining waterproofing.
- B. Install geo-textile levelling layer over entire area to receive deck sheet. Lap edges at least 102 mm and spot adhere fabric to deck as required to keep in position as waterproofing sheet is placed in position. Trim fabric using scissors or utility blades; do not use welding equipment to cut fabric.



- C. Apply deck sheet over area, lapping edges at least 76 mm for machine welding or at least 102 mm for hand welding. Hot-air welds sheets.
- D. Hot-air weld three-way overlaps or T-joints with a 102-mm- round or -square patch.
- E. Secure perimeter of deck sheet with manufacturer's standard metal termination bars and accessories as recommended by manufacturer for each condition.
- F. At deck drains, spread sealant bed over drain flange and lap membrane into drain flange according to membrane manufacturer's written instructions; securely seal sheets in place with clamping ring.
- G. Perform field quality-control flood testing before subsequent work.
- H. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

#### 1.5. COMPARTMENTED, LOOSELY LAID SHEET INSTALLATION

- A. General: Install compartmented, loosely laid sheets over entire area to receive waterproofing according to manufacturer's written instructions.
  - 1. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
  - 2. Install laps shingled with slope of deck where possible.
  - 3. Install flashings concurrently with deck sheet.
  - 4. Perform hot-air welding to ensure a watertight seam installation. Inspect outside edge of seams with pointed metal probe and ensure completed laps lay flat and are free of voids, fishmouths, or wrinkles.
  - 5. Install temporary cut-offs if work is interrupted. Remove the cut-offs completely before proceeding with the installation.
  - 6. Install sheets and auxiliary materials to tie into adjoining waterproofing.
- B. Construct a test containment grid before beginning installation. Perform manufacturer's recommended peel test on the test containment grid and on each day's completed waterproofing work before resuming the following day's installation.
- C. Install sub-membrane containment grid to form compartments secured by containment strips. Also, install containment strips at the base of walls, curbs, penetrations, terminations, and transitions and at the perimeter of the installation. Secure containment grid to substrate with bonding adhesive.
- D. Install geo-textile levelling layer over entire area between containment strips. Lap edges at least 102 mm and spot adhere fabric to deck as required to keep in position as waterproofing sheet is placed in position. Trim fabric even with edges of containment strips using scissors or utility blades; do not use welding equipment to cut fabric.



- E. Control-Test-Drain Installation: Drill 25-mm- diameter hole through the substrate at or near the low point of each compartment and install control test drain, according to manufacturer's written instructions, so as to enable verification of the absence or presence of leaks from underside of waterproofed slab.
- F. Apply deck sheet over area, lapping edges at least 76 mm for machine welding or at least 102 mm for hand welding. Hot-air welds the sheet to containment strips.
- G. Hot-air weld three-way overlaps or T-joints with a 102-mm- round or -square patch.
- H. Install flashing at deck drains. Spread sealant bed over deck drain flange, lap flashing membrane into drain flange and over containment strips according to membrane manufacturer's written instructions, and hot-air weld flashing to containment strips; securely seal flashing sheet in place with clamping ring.
- I. Perform field quality-control flood testing before subsequent work.
- J. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

#### **1.6. SHEET-FLASHING INSTALLATION**

- A. Form wall flashings exposed in final construction using exposed sheet flashing; otherwise, use concealed sheet flashing.
- B. Lap sheet flashings over deck sheet or containment strips. Flash penetrations and field-formed inside and outside corners with sheet flashing.
- C. Extend flashings a minimum of 203 mm above the overburden unless otherwise indicated on Drawings and acceptable to waterproofing manufacturer.
- D. Hot-air weld joints with deck sheet or containment strips and end laps of overlapping sheet flashings and accessories to ensure a watertight seam installation.
- E. Hot-air weld three-way overlaps or T-joints with a 102-mm- round or -square patch.
- F. Secure flashings along top edge with mechanically anchored metal termination bar or with mechanically anchored metal reglet for subsequent metal counterflashing. Seal top of termination with sealant.
- G. Terminate deck sheet at expansion joints and discontinuous deck-to-wall or deck-to-deck joints. Bridge and cover joints with sheet flashing and joint accessories according to manufacturer's written instructions for each type of joint.

#### **1.7. PROTECTION COURSE INSTALLATION**

- A. Install separation layer over sheet waterproofing before placing protection course.



- B. Install protection course over sheet waterproofing or separation layer according to manufacturer's written instructions and before beginning subsequent construction operations. Minimize exposure of membrane.

#### **1.8. MOULDED-SHEET DRAINAGE-PANEL INSTALLATION**

- A. Place and secure moulded-sheet drainage panels, with geo-textile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geo-textile to maintain continuity. Protect installed panels during subsequent construction.

#### **1.9. INSULATION INSTALLATION**

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 19 mm of projections and penetrations.
- B. Lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

#### **1.10. PLAZA-DECK PAVER INSTALLATION**

- A. Install concrete pavers in locations indicated according to manufacturer's written instructions.
- B. Accurately install paver pedestals and accessories in locations and to elevations required. Adjust for final level and slope.
- C. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.
  - 1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.
- D. Install pavers to vary not more than 1.6 mm in elevation between adjacent pavers or more than 1.6 mm from surface plane elevation of individual paver.
- E. Maintain tolerances of paving installation within 1:48 of surface plane in any direction.

#### **1.11. FIELD QUALITY CONTROL**

- A. Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; membrane application, flashings, protection, and drainage components; and to furnish daily reports to The Engineer.
- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
  - 1. Flood to an average depth of 64 mm with a minimum depth of 25 mm and not exceeding a depth of 100 mm. Maintain 51 mm of clearance from top of sheet flashings.
  - 2. Flood each area for 72 hours.



3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- C. The Contractor will engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
- D. Prepare test and inspection report.

#### **1.12. PROTECTION, REPAIR, AND CLEANING**

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

### **3.5.3 SECTION 07 14 16 – COLD - FLUID APPLIED WATERPROOFING**

#### **3.5.3.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Fluid applied membrane waterproofing.

##### **1.2. RELATED REQUIREMENTS**

- A. Section 079200 - Joint Sealers: Sealant for joints in substrates.

##### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. ASTM C 836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric
2. Waterproofing Membrane for Use with Separate Wearing Course; 2006.
3. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension; 2006a.
4. ASTM D 2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2005.
5. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

##### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane.



- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Kahramaa's name and registered with manufacturer.

#### **1.5. QUALITY ASSURANCE**

- A. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with three years experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

#### **1.6. WARRANTY**

- A. See Section 017700 - Closeout Submittals, for additional warranty requirements.
- B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Kahramaa.

#### **3.5.3.2 PART 2 - PRODUCTS**

##### **1.1. MANUFACTURERS**

- A. Single component, bitumen modified, and polyurethane based waterproofing membrane (WP-5):
  - 1. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in.
  - 2. Substitutions: See Section 016000 - Product Requirements.

##### **1.2. MEMBRANE MATERIALS**

- A. Fluid-Applied Waterproofing - Single component, bitumen modified, cold liquid applied Moisture curing urethane based waterproofing membrane complying with ASTM C 836.
  - 1. Shore A Hardness: 40 +/- 5, per ASTM D 2240.
  - 2. Elongation: 600 percent, per ASTM D 412.
  - 3. Tensile Strength: 150 lb/sq.in. (1,035 kPa) +/- 5 lb/sq.in. (35 kPa), per ASTM d 412.
  - 4. 100 percent Modulus: 80 lb/sq.in. (550 kPa) +/- 5 lb/sq.in. (35 kPa), per ASTM d 412.
  - 5. Crack Bridging: Pass1/16 in. (1.6 mm) with no loss of bond or cracking exhibited, cycled
  - 6. 10 times per 24 hrs. at 15 degrees F (- 9 degree C) per ASTM C 836.
  - 7. Swelling in water (3 days at room temperature): Nil.
  - 8. Weatherometer (Atlas Xenon Arc 1000 hrs.): No Cracking, No hardening.
  - 9. Moisture Vapor Permeability: 0.15 perm inches (0.22 ng/pa second m) per ASTM E 96.
  - 10. Service Temperature range: ~ 40 to + 120 degrees F (- 40 to + 49 degrees C).



11. Minimum recovery: 90%

### **3.5.3.3 PART 3 - EXECUTION**

#### **1.1. EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify that items that penetrate surfaces to receive waterproofing are securely installed.

#### **1.2. PREPARATION**

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.  
Vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to manufacturer.
- D. Seal cracks and joints with sealant using methods recommended by sealant manufacturer.

#### **1.3. INSTALLATION**

- A. Conform to NRCA Waterproofing and Dampproofing Manual drawing details as noted:
- B. Apply waterproofing in accordance with manufacturer's instructions to specified minimum thickness.

### **3.5.4 SECTION 07 16 13 – POLYMER MODIFIED CEMENT WATERPROOFING**

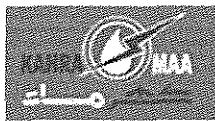
#### **3.5.4.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Waterproofing for potable water contact applications.
  1. Inside of potable water tank.
- B. Waterproofing for positive hydrostatic pressure applications.
  1. Inside surfaces of water features and fountains.

##### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:
  1. Civil & Structural Specifications - Cast-in-Place Concrete: Concrete to be waterproofed.
  2. Section 079000 - Joint Sealers: Sealing of moving joints in waterproofed surfaces.
  3. Section 092400 - Portland Cement Plaster: Plaster to be installed over waterproofing.



4. Section 093000 - Tile: Mortar setting bed to be installed over waterproofing.

5. Related Sections of Mechanical Divisions.

#### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. ASTM C 109/C 109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2007.
2. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a.
3. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

#### **1.4. SUBMITTALS**

- A. See Section 013000- Administrative Requirements, for submittal procedures.

- B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Details of joints and intersections.

- C. Test Reports: Where testing is explicitly called for, submit reports showing tests to pressure equal to or higher than that specified, with satisfactory lack of leakage.

- D. Certification: Provide manufacturer's certification that waterproofing to be provided is suitable for the purpose specified and the locations where it is intended to be installed and that the requirements of the contract documents do not preclude satisfactory installation and performance.

- E. Certification: For potable water contact, submit evidence of current NSF certification.

- F. Maintenance Data: Instructions for care and repair of damaged coatings.

#### **1.5. QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum three years of documented experience and approved by manufacturer.

- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Locate where directed.
2. Finish areas designated by the Engineer.
3. Do not proceed with remaining work until workmanship, colour, and texture are approved by the Engineer.



4. Refinish mock-up area as required to produce acceptable work.

#### 1.6. DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original packaging, marked with manufacturer's product identification.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Keep stored products dry; store under cover and elevated above grade.

#### 1.7. FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

#### 1.8. WARRANTY

- A. See Section 017700 - Closeout Submittals, for additional warranty requirements.

#### 3.5.4.2 PART 2 - PRODUCTS

##### 1.1. MANUFACTURERS

- A. Polymer-Modified Cementitious Waterproofing:

1. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in.

##### 1.2. MATERIALS

- A. Two component Acrylic Cementitious Elastomeric Flexible Waterproof membrane:

1. Acceptable Physical Properties:

- a. Maximum Particle Size: 0.63 mm.
- b. Water Vapour Permeability (MCO<sub>2</sub>): 985
- c. CO<sub>2</sub> Permeability (MCO<sub>2</sub>): 100000
- d. Water Resistance:

- 1) Positive Pressure: 1.5 bar
- 2) Negative Pressure: 1.0 bar

- e. Water Absorption (ASTM 642C): 1.48%
- f. Capillary Water Absorption:  $17.5 \times 10^{-3}$  kg/m<sup>2</sup>h<sup>0.5</sup> g. Elongation (28 days)

- 1) Ambient: 23.4%
- 2) Under Water: 16.2%

- g. Strength (39 days) N/mm<sup>2</sup>
- 1) Tensile: 0.64
- 2) Adheaves: 1.00



2. Crack Repair Material, Joint Tape, and Reinforcing: Type and application as recommended by waterproofing manufacturer.
3. Water: Clean, clear, non-alkaline potable water, free of salts and other harmful elements.

#### **3.5.4.3 PART 3 - EXECUTIONS**

##### **1.1. EXAMINATION**

- A. Examine surfaces where waterproofing is to be applied for conditions detrimental to satisfactory performance.
- B. Do not begin installation until substrates have been properly prepared.
- C. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

##### **1.2. PREPARATION**

- A. Remove defective concrete and rebuild to original profiles.
- B. Plug active leaks according to waterproofing manufacturer's instructions.
- C. Patch holes and non-moving cracks and joints.
- D. Clean and prepare surfaces thoroughly prior to installation; schedule cleaning and preparation so that residue will not fall on newly coated, uncured surfaces.
- E. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Use sandblasting, water blasting, or acid etching as recommended.
- F. Application of waterproofing constitutes acceptance of substrates.
- G. Protect other work from fallout, overspray, and spatter from waterproofing application; provide temporary enclosures and covers as necessary to do so.

##### **1.3. INSTALLATION**

- A. Install waterproofing in accordance with manufacturer's instructions and recommendations unless more stringent requirements are indicated.
- B. Perform installation only during ambient and substrate conditions recommended by manufacturer; provide temporary enclosures and/or temporary heating as necessary to do so.
- C. Fill voids and holes prior to application of first coat.
- D. Apply the number of coats and at the rates recommended by manufacturer for the specific application but not less than specified minimum thickness; apply at least two coats unless one coat is specifically indicated.
- E. At surfaces exposed to view, apply a uniformly textured finish without major variations in appearance.



- F. Masonry: Complete hiding of masonry joints is required.
- G. Extend waterproofing to all surfaces in areas indicated to form continuous waterproofed surfaces.
  - a. at floors where walls are not treated, extend waterproofing a minimum of 300 mm up walls and columns.
- H. Cure waterproofing by recommended methods for recommended period prior to making waterproofed area available for use or occupancy; protect from too rapid drying, severe weather exposure, and water accumulation.
  - 1. Hot, Dry Weather: Use wet-cure methods regardless of manufacturer's instructions.
  - 2. Do not use covers that could stain waterproofing surfaces.
  - 3. Do not use chemical curing agents unless explicitly approved by waterproofing manufacturer.
  - 4. Do not expose waterproofing to sunlight for minimum of 72 hours after placement.
- I. Do not backfill, fill water or liquid holding structures, or apply finish coatings until time period recommended by manufacturer has passed.

#### **1.4. FIELD QUALITY CONTROL - WATER HOLDING STRUCTURES**

- A. Flood test waterproofing application by filling to capacity and allowing to stand for not less than 24 hours.
- B. If any leaks appear, notify Engineer and drain.
  - 1. Repair leaks at no additional cost to Kahramaa.
  - 2. Repeat flood test until all leakage is eliminated.

### **3.5.5 SECTION 07 16 16 - CRYSTALLINE WATERPROOFING**

#### **3.5.5.1 PART 1 – GENERAL**

##### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2. SUMMARY**

- A. Section includes crystalline waterproofing for positive-side application to concrete and concrete unit masonry.
- B. Related Sections:
  - 1. Civil & Structural Specifications "Cast-in-Place Concrete" for waterstops, concrete slabs serving as floor toppings to protect waterproofing, and finishing concrete walls and slabs to receive waterproofing.
  - 2. Section 042000 "Unit Masonry Assemblies" for construction cleaning of concrete unit masonry walls to receive waterproofing.



3. Section 079200 "Joint Sealants" for elastomeric and preformed sealants in concrete and concrete unit masonry walls and floors.
4. Section 092400 "Portland Cement Plaster" for plaster finishes to be applied over waterproofing.

#### **1.3. ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions and installation instructions for crystalline waterproofing.

#### **1.4. INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Applicator.
- B. Product Certificates: For waterproofing, patching, and plugging materials, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for crystalline waterproofing.
- D. Field quality-control reports.

#### **1.5. QUALITY ASSURANCE**

- A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and that employs workers trained and approved by manufacturer.
- B. Mockups: Provide mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mockup of typical vertical, horizontal surfaces shown on Drawings 0.9 sq. m in size.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless the Engineer specifically approves such deviations in writing.
  3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **C. Pre-installation Conference:** Conduct conference at site.

#### **1.6. PROJECT CONDITIONS**

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit crystalline waterproofing to be performed according to manufacturer's written instructions.
- B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.



- C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 4.4 deg C or above during work and cure period, and space is well ventilated and kept free of water.

#### 3.5.4.2 PART 2 - PRODUCTS

##### 1.1. WATERPROOFING MATERIALS

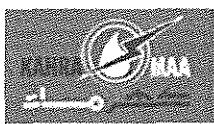
- A. Crystalline Waterproofing: Pre-packaged, gray-coloured proprietary blend of Portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the by-products of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; that has VOC content complying with limits of authorities having jurisdiction; with properties meeting or exceeding the criteria specified below.
1. Available-Manufacturer-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product based on the list of manufacturers as approved by the Engineer:
  2. BASF Building Systems; Tegaproof.
  3. Water Permeability: Maximum zero for water at 9 m when tested according to CE CRD- C 48.
  4. Compressive Strength: Minimum 27.6 MPa<sub>28</sub> days when tested according to ASTM C 109/C 109M.

##### 1.2. ACCESSORY MATERIALS

- A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.
- B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.
- C. Portland Cement: ASTM C 150, Type I.
- D. Sand: ASTM C 144.
- E. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and not to create a vapor barrier.
- F. Water: Potable.

##### 1.7. MIXES

- A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.



- B. Protective Topping: Measure, batch, and mix Portland cement and sand in the proportion of 1:3 and water gauged with a polymer admixture. Blend together with mechanical mixer to required consistency.

#### 3.5.4.3 PART 3 - EXECUTION

##### 1.1. EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.
- B. Proceed with application only after unsatisfactory conditions have been corrected.
- C. Notify Engineer in writing of active leaks or defects that would affect system performance.

##### 1.2. PREPARATION

- A. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.
- B. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
- C. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions.
- D. Repair damaged or unsatisfactory substrate with patching compound according to manufacturer's written instructions.
  1. At holes and cracks in substrate, remove loosened chips and cut reveal with sides' perpendicular to surface, not tapered, and approximately 25.4 mm deep. Fill reveal with patching compound flush with surface.
- E. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.
  1. Clean concrete surfaces according to ASTM D 4258.
    - a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D 4260.
    - b. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.
  2. Clean concrete unit masonry surfaces according to ASTM D 4261.
    - a. Lightweight Concrete Unit Masonry: Etch with 10 percent muriatic (hydrochloric) acid solution or abrade surface by wire brushing. Remove acid residue until pH readings of water after rinse are not more than 1.0 pH lower or 2.0 pH higher than pH of water before rinse.



- b. Medium- and Normal-Weight Concrete Unit Masonry: Sandblast or bushhammer to a depth of 1.6 mm.
- 3. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.

#### **1.3. APPLICATION**

- A. General: Comply with waterproofing manufacturer's written instructions for application and curing.
  - 1. Saturate surface with water for several hours prior to application and maintain damp condition until applying waterproofing. Remove standing water.
  - 2. Apply waterproofing to surfaces indicated on Drawings.
  - 3. Number of Coats: Three.
  - 4. Application Method: Brush or Spray. Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.
  - 5. Dampen surface between coats.
- B. Final Coat Finish: Smooth.
- C. Curing: Moist-cure waterproofing for three days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.
- D. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:
  - 1. Onto columns integral with treated walls.
  - 2. Onto interior non-treated walls intersecting exterior treated walls, for a distance of 600 mm for cast-in-place concrete and 1200 mm for masonry.
  - 3. Onto exterior walls and onto both exterior and interior columns, for a height of 300 mm, where floors, but not walls, are treated.
  - 4. Onto every substrate in areas indicated for treatment, including pipe trenches, pipe chases, pits, sumps and similar offsets and features.
- E. Protective Topping: Apply 25.4-mm thick, protective topping over floor surfaces.

#### **1.4. FIELD QUALITY CONTROL**

- A. Inspection: Engage manufacturer's representative to inspect completed application and provide a written report that application complies with manufacturer's written instructions.

**END OF SECTION 07 16 16**

### **3.5.6 SECTION 07 18 00 – TRAFFIC COATINGS**

#### **3.5.6.1 PART 1- GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Section includes:
  - 1. Provide complete polyurethane waterproofing coating system where indicated on the Drawings, including all applicable sealants and elastomeric flashings needed to ensure a complete



waterproof and weather tight system for deck, ramp and raised curb surfaces at locations indicated.

2. Parking lot markings, including parking bays, crosswalks, arrows, handicapped symbols, curb markings, and lane markings.
- B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

#### **1.2. RELATED SECTIONS**

- A. Section 033000 - Cast in place concrete.
- B. Section 058100 - Expansion Joint Cover Assemblies.
- C. Section 079200 - Sealants.

#### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:
  1. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension; 2006a.
  2. ASTM D 903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Re-approved 2004).
  3. ASTM D 4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2007.
  4. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008.
  5. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

#### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product data:
  1. Materials list of items proposed to be provided under this Section;
  2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
  3. Shop Drawings or catalogue illustrations in sufficient detail to show installation and interface
  4. of the work of this Section with the work of adjacent trades;



5. Manufacturer's current recommended installation procedures which, when reviewed by Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.
  6. Written documentation of applicator's qualifications, including reference projects of similar scope and complexity, with current phone contacts of Engineer and Kahramaa for verification.
- C. Samples: Submit two samples of cured membrane, 300x300 mm in size, illustrating colour, surface texture, and variations.
- D. Manufacturer's Installation Instructions: Include special environmental conditions required to install traffic membrane and potential incompatibilities with adjacent materials.
- E. Maintenance Data: Include procedures for stain removal, repairing surface, and cleaning.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Kahramaa's name and registered with manufacturer.
- 1.5. QUALITY ASSURANCE**
- A. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.
- B. Applicator qualifications:
1. Applicator shall have at least three years experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.
  2. Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.
- C. Convene a pre-installation job-site conference four weeks prior to commencing work of this Section:
1. Secure attendance by Engineer, Contractor, applicator, and authorized representatives of the coating system manufacturer and interfacing trades.
  2. Examine Drawings and Specifications affecting work of this Section, verify all conditions, review installation procedures, and coordinate scheduling with interfacing portions of the Work.
- 1.6. MOCK-UP**
- A. Provide mock-up, 6 m long by 3 m wide, with membrane system applied to representative substrate.
- B. Locate as per Engineer direction.
- C. Mock-up may remain as part of the Work.
- 1.7. DELIVERY, STORAGE, AND HANDLING**
- A. Deliver materials to job site in manufacturer's unopened containers with all labels intact and legible at time of use.



- B. Maintain the products in accord with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.

**1.8. SUBSTRATE CONDITIONS**

A. General:

1. Provide applicator with surfaces that are broom clean, dry, sound and free of voids, bugholes, rockpockets, honeycombs, protrusions, excessive roughness, foreign matter, frost, ice and other contaminants which may inhibit application or performance of the waterproofing coating system.
2. Using suitable abrasive methods, remove residue of form release, curing compound, chemical retarders and other surface treatments, mortar smear, saw cutting residue, mill scale, rust, loose material and other contaminants from concrete, masonry and ferrous metal surfaces to receive the work of this Section.

- B. Concrete: Where work of this Section will be applied to concrete, provide surfaces that are smooth with finish equal to one that is light steel troweled followed by a fine hair broom.

C. Decks:

1. Slope deck surfaces to drains that have flanges at coating level which are flush with deck surfaces.
2. Rigidly install pipe, vents and other surface protrusions, properly flash them, and cover to prevent entry of coating materials.

- D. Joints: Configuration shall be consistent with this Section and with all other requirements of the Contract Documents.

**1.9. WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

- B. Provide 10 year manufacturer warranty.

1. Include coverage for delamination of system from substrate.

**3.5.6.2 PART 2 - PRODUCTS**

**1.1. MANUFACTURERS**

A. Traffic Membrane:

1. Refer Product of BASF, FOSROC, SIKA,
2. Or equivalent.
3. Substitutions: See Section 016000 - Product Requirements.

**1.2. MATERIALS**



A. General:

1. Provide complete liquid applied polyurethane waterproofing coating system having the following minimum attributes:
  - a. All components of the coating system shall be compatible to each other and from same manufacturer.
  - b. System designed for concrete decks subject to vehicular traffic;
  - c. Complying with ASTM C957-91 and having a Class A fire rating on concrete surfaces;
  - d. Install manufacturer's standard-duty vehicular traffic deck system on parking areas from curbs to end of striped parking stalls and raised curb areas indicated;
  - e. Install manufacturer's heavy-duty vehicular traffic deck system on ramps, drive aisles and turn areas;
  - f. Colour to be selected by Engineer from manufacturer's standard colour range.

B. POLYURETHANE, Protective traffic-deck coating system (Parking) - A.FC.01

1. UV stable, multi-layered, durable, polyurethane deck coating system to provide seamless, protective wear resistant, profiled surface.
2. The coating system shall comprise the following:
  - a. A high grade, low viscosity, 2 component epoxy resin primer and substrate sealer.
  - b. A graded, high purity, quartz aggregate with a particle size in the range 0.3 - 0.9 mm.
  - c. Single component polyurethane top coat.
3. Technical Properties (top coat):
  - a. Density: 1.48 g/cm<sup>2</sup>.
  - b. Tensile Strength (min.): 25 N/mm<sup>2</sup>
  - c. Solid Content: 83%
  - d. Elongation (ASTM D638): 46%
  - e. Tear Strength: 45 N/mm<sup>2</sup>.
  - f. Taber abrasion (ASTM D 4060 part 1): 1.02 (g/1000 cycles)

C. SEAMLESS, self-smoothing heavy duty polyurethane based flooring system (corridors, Loading /unloading bays): – A.FC.02

1. UV stable, a multi-component, polyurethane based system for the protection of concrete floor subject to high levels of traffic, impact and abrasion. Enhanced flexibility provides excellent impact resistance and reduces the risk of cracking due substrate movement. It should be available in smooth or slip-resistant profile.



2. The coating system shall comprise the following:
  - a. A high grade, low viscosity, 2 component epoxy resin primer and substrate sealer.
  - b. A hard but flexible, solvent free 2-component, self-smoothing compound based on the latest polyurethane technology that produces hard-wearing, smooth or non-slip floor surfaces.
  - c. A 2-component pigmented or clear polyurethane coating which, when applied to coatings produces a flexible wear-resistant and durable seamless surface.
  - d. A graded, high purity, quartz aggregate with a particle size in the range 0.3 - 0.9 mm.
  - e. Slip resistance shall be tested for slip resistance in accordance with BS 7976-2:2002.
  - f. Coverage: Primer: 0.15-0.3 kg/m<sup>2</sup> depending on surface texture and porosity. Hard/Flexible: Approx. 2.5-4.0 kg/m<sup>2</sup> Pigmented or Clear Polyurethane: 0.10-0.12 kg/m<sup>2</sup> per coat
  - g. Thickness of Coating: 1.15 - 2.5 mm depending on surface profile required.
  - h. Technical Properties:
    - 1) Density: 1.09 g/cm<sup>2</sup>.
    - 2) Pot Life: 20 mins at 25°C
    - 3) Bonding Strength: greater than cohesive strength of typical good quality concrete substrate.
    - 4) Application temperature: 10°C to 40°C substrate temp.
    - 5) Tensile Strength DIN 53 504 : approx. 30 N/mm<sup>2</sup>
    - 6) Breaking Elongation DIN 53 504 : approx. 10%
    - 7) Pressure resistance: approx. 65 N/mm<sup>2</sup>
    - 8) Flexural strength: approx. 32 N/mm<sup>2</sup>
    - 9) Shore – D – hardness: 75
    - 10) Elasticity module DIN 53 457: approx. 1200 N/mm<sup>2</sup>

D. MULTI COMPONENT solvent free epoxy floor coating system (Stair)

1. UV stable, a multi component solvent free epoxy floor coating system designed to offer continuous seamless floor protection thicknesses between 0.8 mm – 1.5 mm. It shall be applied to produce either a smooth or profiled finish.
2. The coating system shall comprise the following:



- a. It shall be good wear and abrasion resistance and is suitable for use in many industrial applications. It can be used as a surface coating where a hygienic and high gloss appearance is required.
- b. It shall be provided with impermeable protection against common oils, greases, lubricants or oils such as skydrol. It offers good general chemical resistance, but as in all corrosive situations.
- c. It shall be limited maintenance and Durable.
- d. Technical Properties.
  - 1) Mixed Density at 25°C: 1.556 g/cm<sup>2</sup>.
  - 2) Pot Life: 40 mins at 25°C
  - 3) Curing Time: 15 hours.
  - 4) Maximum service temperature: 60°C.
  - 5) Tensile Strength (BS 63189-part 7) : 15.0 N/mm<sup>2</sup>
  - 6) Flexural strength (BS 6319 PART 3): 19.0 N/mm<sup>2</sup>
  - 7) Slip resistance (TRL rubber) profiled surface: 85

**E. THERMOPLASTIC Traffic Arrows & Signage's Marking Paint (Parking)**

- 1. UV stable, a high performance, highly durable waterborne traffic marking material. Unique patented cross linking technology provides durability normally associated with Hot-melt Thermoplastics and epoxies. Liquid thermoplastic meets and exceeds the performance requirements of Federal Specification TTP-1952E Type III.
- 2. Thermoplastic can be applied with conventional spray equipment (with Stainless steel components) to Asphalt, concrete, or existing road marking that are adhering well to the pavement surface, and Features include:
  - a. Unique cross linking chemistry
  - b. Safety, no heating required as with hot melt thermoplastics.
  - c. Single component system, no need to blend as with epoxy systems.
  - d. Can be used over cement or asphalt surfaces
  - e. Meet and exceeds TTP-1952 E Type III.
- 3. Composition: 100 % acrylic emulsion cross-linking resins, specialty pigments, surfactants, and fillers.
- 4. Colour: White, Yellow.



5. Limitations: Apply to clean dry surface when surface and air temperature is not expected to drop below 50°F or exceed 120°F in a 24 hour period.
6. Technical Properties (Chemical & Physical Analysis).

	White	Yellow
• Volatile Organic Content (VOC)	<150 g/l	< 150 g/l
• Viscosity (KU)	80 – 90	80 - 90
• Solid by Volume %	61	61
• Solids by weight %	77.5	76.5
• Pigment Volume Content %	60.00	60.00
• Pigment Solids by Weight %	61.10	62.00
• Dry Opacity	.965	.965
• Directional Reflectance	86%	50%
• Drying time for no pickup, min	<6 min	<6 min
• Fineness of dispersion, Hegman	3	3
• Heat-Shear Stability Consistency, KU	68-105	68-105
• Bleeding Ratio	.95	-
• Scrub resistance	< 1500 Cycles	< 1500 Cycles

7. Environmental Considerations: THERMOPLASTIC Traffic marking Paint is an environmentally friendly, 100% acrylic emulsion traffic paint containing less than 100 grams per litre volatile organic content (VOC).
8. Coverage: 155-180 ft. of 4-inch line per gallon of 30-35 mils wet film thickness.
9. Refer Products by Jotun, Hempell or equivalents.

### 1.3. ACCESSORIES

- A. Primer: As recommended by coating system manufacturer.
- B. Joint backing: Closed-cell, polyethylene rod as recommended by coating manufacturer.
- C. Aggregate: 20-30 mesh silica sand; local aggregate approved by coating manufacturer.
- D. Sealant: As recommended by membrane manufacturer, and compatible with system and adjacent materials.
- E. Use compatible pavement marking system recommended by traffic membrane manufacturer.



- F. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor and approved by the coating system manufacturer as compatible, subject to review of the Engineer.

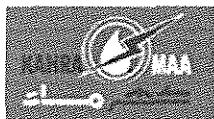
#### **3.5.6.3 PART 3 - EXECUTIONS**

##### **1.1. SURFACE CONDITIONS**

- A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.
- B. Applicator shall examine the areas and conditions under which work of this Section will be performed.
  - 1. Verify conformance with manufacturer's requirements;
  - 2. Report unsatisfactory conditions in writing to the Engineer;
- C. Do not proceed until unsatisfactory conditions are corrected.
- D. Report unsatisfactory conditions in writing to the Engineer;
- E. Do not proceed until unsatisfactory conditions are corrected.

##### **1.2. PREPARATION**

- A. Surface preparation and detailing procedures to be in accord with waterproof coating system manufacturer's instructions and recommendations except where more stringent requirements are indicated.
- B. Abrade concrete surfaces by light bead-blast to remove laitance and provide surface texture resembling 100 grit sandpaper.
- C. Clean all deck surfaces to receive coating system in accord with manufacturer's instructions; vacuum clean or blow clean with oil-free compressed air all surfaces to receive sealants, detailing materials or coatings immediately prior to installation.
- D. Rout, clean, prepare and detail surface cracks in accord with manufacturer's instructions; install backer rod where required.
- E. Clean metal surfaces to bright metal by wire brushing or mechanical etching; scuff-sand lead flashing and plastic surfaces.
- F. Prime surfaces in accord with manufacturer's instructions.
- G. Install 1/4" diameter backer rod into corner of all horizontal-to-vertical junctures subject to movement and cover with 1" detail cant of approved sealant; install 1" detail cants at projections, curbs and other horizontal-to-vertical junctures.
- H. Install detail coats, joint and crack treatments, and liquid flashings in accord with manufacturer's instructions.



- I. Allow detail applications to cure in accord with manufacturer's instructions prior to general application of coating.

**1.3. APPLICATION**

- A. Install waterproof coating system in accord with manufacturer's recommendations and instructions as applies to the Work except where more stringent requirements are indicated.

1. Grid deck surfaces to assure proper coverage rates and verify coating wet-film mil thickness with gauges as work progresses.
2. Retain empty product containers during course of work to aid in determining whether completed coating system complies with manufacturers average thickness requirements.

- B. Verify proper dry condition of substrate using method recommended by coating system manufacturer; perform adhesion checks prior to general application of coating system using field adhesion test method recommended by manufacturer.

- C. Mask off adjoining surfaces not to receive coating system.

- D. Wipe clean all detail coats with white rags wetted with Xylene solvent; do not saturate detail coat.

- E. Apply coating base coat uniformly and allow curing in accordance with manufacturer's instructions.

- F. Feather edge when entire area cannot be completed in one day; clean area 6" wide along edge of coating with Xylene solvent on clean white rags prior to start-up on next working day; use interlaminary primer per manufacturer's instructions as needed; overlap existing work by 6" with new work.

- G. Mix and apply coating system intermediate wear coats in accord with manufacturer's instructions for wear balance specified; immediately broadcast aggregate into wet material at rate recommended by manufacturer; disperse aggregate through a hopper fed, low pressure air blower in a manner to ensure uniform coverage over entire surface and backroll to evenly distribute and totally encapsulate; allow to cure per manufacturer's instructions.

- H. Apply coating system finish coat in accord with manufacturer's instructions.

**1.4. INSTALLATION**

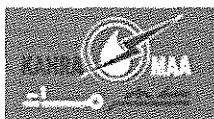
- A. Apply system materials in accordance with manufacturer's instructions.

**1.5. PROTECTION AND CLEAN-UP**

- A. Promptly remove primer or coating material from adjacent surfaces with MEK, Toluene or Xylems; leave work area in broom clean condition.

- B. Allow completed Work to cure 72 hours before opening to vehicular traffic.

**END OF SECTION 07 18 00**



### **3.5.7 SECTION 07 21 00 – THERMAL INSULATION**

#### **3.5.7.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Supply and installation of rigid board insulation, semi-rigid insulation and batt insulation as indicated on Drawings and specified herein, but excluding insulation contained within Curtain wall spandrel panels as specified in Façade Specifications.
- B. Batt insulation and vapour retarder in exterior wall, ceiling, and roof construction.

##### **1.2. RELATED REQUIREMENTS**

###### **A. Related requirements as referenced:**

1. Civil & Structural Specifications - Cast-in Place Concrete
2. Section 042000 - Unit Masonry Assemblies
3. Section 078413 – Penetration Firestopping.
4. Section 092216 – Non-Structural Metal Framing
5. Section 092300 - Gypsum Plastering.

##### **1.3. REFERENCE STANDARDS**

- A. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2007.
- B. ASTM D 2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2006.
- C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008.
- D. ASTM E 136 - Standard Test Method for Behaviour of Materials in a Vertical Tube Furnace At 750 Degrees C; 2004.
- E. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; 2003.

##### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Samples: Submit 300 x 300 samples of each specified type of insulation to site.

##### **1.5. FIELD CONDITIONS**

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

##### **1.6. COORDINATION**

- A. Coordinate the work with Section 072500 for installation of vapour retarder.

##### **1.7. DELIVERY, STORAGE AND HANDLING**



- A. Package insulation materials and label them to designate manufacturer, type, density and insulation value, and reference standard specification number if applicable.
- B. Store insulation materials in dry areas, protected from wetting and traffic. Store insulation board flat, on a flat surface, and to prevent edge damage and placing of materials on top of stored boards.

#### **3.5.7.2 PART 2 - PRODUCTS**

##### **1.8. GENERAL**

- A. Ensure that all materials of an insulation system, and the construction with which it is in contact, are compatible.
- B. Ensure that others whose installations are affected are informed of the thickness and installation methods of board to be installed.

##### **1.9. BOARD INSULATION MATERIALS**

- A. Extruded Polystyrene Board Insulation: Extruded polystyrene board, ASTM C 578; with the following characteristics:
    1. Board Size: 1200x2400 mm.
    2. Board Thickness: As indicated in the drawings
    3. Board Edges: Shiplap.
    4. Water Absorption: 4% by volume, maximum, when tested in accordance with ASTM D 2842.
    5. Surface Burning Characteristics: Flame spread/Smoke developed index of <75 / <450, when tested in accordance with ASTM E 84.
    6. Board Density: 3.5 kg/cu m.
    7. Compressive Resistance: 210 kPa. 50mm.
    8. Thermal Conductivity (k factor) at 23.8 degrees C: 0.029.
    9. Manufacturer: Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in.
    10. Substitutions: See Section 016000 - Product Requirements.
  - B. Rigid glass or mineral fiber board: Un-faced wall insulation:
    1. Type 703 by Owens- Corning Fiberglass corp.
    2. Type 434 Rockwool Lapinus.
    3. Termolan by Termolan S.P.A. or equivalent as approved.
    4. Density: 80 kg/cu.m
    5. Thickness: As shown in the Drawing
  - C. Rigid Polyurethane Board: Extruded cellular polyurethane, faced on each side with black coated glass tissue, 200 kN/sq.m compressive strength at 10%; Purlscreed by Coolag, or pro- Memb by Canadian Hanson Limited, or equivalent by GAF Corporation; or equivalent as approved.
- ##### **1.10. BATT INSULATION MATERIALS**
- A. Batt Insulation: ASTM C 665; preformed batt; friction fit, conforming to the following:
    1. Surface Burning Characteristics: Flame spread index of 25 or less; smoke developed index of 450 or less, when tested in accordance with ASTME 84.
    2. Combustibility: Non-combustible, when tested in accordance with ASTME 136.



3. Formaldehyde Content: Zero.
4. Facing: Un-faced.
5. Manufacturer: Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in..
6. Substitutions: See Section 016000 - Product Requirements.

#### **1.11. ACCESSORIES**

- A. Sheet Vapour Retarder: Specified in Section 072500.
- B. Z-bars:
  1. Formed hot dip galvanized sheet steel, to suit thickness of insulation, minimum, 50mm wide and 1 mm thick.
- C. Adhesive and Primer for Adhesive:
  1. Compatible and permanent type with insulation, and as recommended by insulation board manufacturer for installations indicated in drawings.
- D. Fasteners for Insulation:
  1. Fasteners for Rigid Insulation (above grade installation): Type N stick-clip fasteners and Type S neoprene adhesive, with self-locking washers, of impale type, perforated 50 x 50mm cold rolled steel, 0.8mm thick adhesive pack, spindle of 2.7mm dia. Annealed steel, length to suit insulation 25mm dia. Washers of self-locking nylon.
  2. Integral Sacrament Channels: Minimum 0.5512mm galvanized 42mm wide x 13mm deep thermal stud channel, and slotted insulation board system.
  3. Strip Implement Clips: 25mm wide strip of proprietary insulation holding strips fabricated from 0.46mm galvanized sheet metal in 30m rolls with punch-out insulation securement arrows.

#### **3.5.7.3 PART 3 - EXECUTION**

##### **3.1. EXAMINATION**

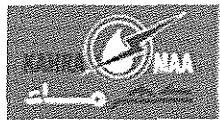
- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

##### **3.2. INSTALLATION**

###### **A. General:**

1. Install boards in largest panel sizes possible in order to cover areas by full length panels and to minimize cutting and number of joints. Coordinate panel width with spacing of z-bars as required by metal installation.
2. Stagger cross joints between panels.
3. Butt boards with moderate contact, and cut and fit them tightly around other construction elements.

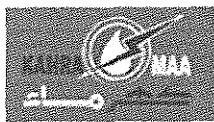
##### **3.3. PROTECTION**



**Qatar General Electricity & Water Corporation  
Tender No. GTC 626/2014  
Construction of Mega Reservoirs PRPSs  
(Package A, B, C, D & E)**

- A. After installation, provide polystyrene insulation subject to damage by sunlight and similar adverse environmental conditions with adequate opaque protection against damage as recommended by manufacturer.
- B. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION 07 21 00**



### **3.5.8 SECTION 07 25 00 - WEATHER BARRIERS**

#### **3.5.8.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Vapour Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapour-resistant and air-tight.

##### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:

1. Civil & Structural specifications - Cast-In-Place Concrete.
2. Section 042000 - Unit Masonry Assemblies.
3. Section 072100 - Thermal Insulation: Vapour retarder installed in conjunction with batt insulation.
4. Section 081113 – Hollow Metal Doors and Frames.
5. Section 081216 - Aluminium Doors and Frames.
6. Façade Specifications - Metal Framed Curtain Walls.

##### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
2. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2002.
3. ASTM E 96/E 96M - Standard Test Methods for Water Vapour Transmission of Materials; 2005.

##### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

##### **1.5. FIELD CONDITIONS**

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

#### **3.5.8.2 PART 2 - PRODUCTS**

##### **1.1. WEATHER BARRIER ASSEMBLIES**

##### **1.2. APPLICATIONS**

- A. Outside Surface of inside Wythe of Exterior Masonry Cavity Walls: Two Component Polymer Modified Bituminous Compound.
- B. Outside surface of the external block wall and concrete column, beam and other concrete portions behind GRC or stone cladding.

##### **1.3. ROLLER APPLIED COATING**



- A. Roller applied coating: Two Component Polymer Modified Bituminous Compound capable of being applied to un-plastered hollow block wall and which to be covered with rigid insulation boards.
  - 7. Film Thickness: As per manufacturers' written recommendation to suit the condition where the product to be applied.
  - 8. Absorption: Nil
  - 2. Bond Strength: Min. 0.2 N/mm<sup>2</sup>
  - 3. Resistance to Fungal Growth
  - 4. Application Temperature: + 5 degrees C to + 40 degrees C.
  - 5. Suitable for use on concrete and masonry.
  - 6. Crack Bridging: >10mm.
  - 7. Shall be resistant to CO<sub>2</sub>, SO<sub>2</sub>, Chlorides, Weak acids, SO<sub>3</sub> and other common chemicals.
  - 8. Shall be free from asbestos.
- B. Product & Manufacturer: Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in.

#### **1.4. SELF ADHERING VAPOUR BARRIER MEMBRANE**

- A. Air/vapour barrier membrane (Self-Adhering): Blueskin SA as manufactured by Bakor, a SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film. For application temperatures down to - 120C use Blueskin SA LT. Membrane shall have the following physical properties:
  - 1. Thickness: 1.0 mm (40 mils).
  - 2. Air leakage: <0.01 L/s/m<sup>2</sup> @ 75 Pa to ASTM E283-91;
  - 3. Water vapour performance: 2.8 ng/Pa.m<sup>2</sup>.s (0.05 perms) to ASTM E96;
  - 4. Low temperature flexibility: -30 C to CGSB 37-GP-56M;
  - 5. Elongation: 200% to ASTM D412-modified;

#### **1.5. ACCESSORIES**

- A. Thinners and Cleaners: As recommended by material manufacturer.

#### **3.5.8.3 PART 3 - EXECUTION**

##### **1.1. EXAMINATION**

- A. Verify that surfaces and conditions are ready to accept the work of this section.

##### **1.2. PREPARATION**

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

##### **1.3. INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.

##### **1.4. INSTALLATION**



- A. Apply by roller to the thickness in clause 2.03.1
  - B. Install materials in accordance with manufacturer's instructions.
  - C. Install air and vapour seal materials and assemblies in conjunction with materials described in other sections to provide continuous sealed barrier in the exterior enclosure of the building.
- 1.5. PRIMER FOR SELF ADHERING MEMBRANE**
- A. Apply primer for self-adhered membranes at rate recommended by manufacturer.
  - B. Apply primer by either roller or spray and allow minimum 30 minute open time. Primed surfaces not covered by Blueskin SA sheet membrane during the same working day must be re-primed.
- 1.6. VAPOUR BARRIER MEMBRANE**
- A. Apply Blueskin SA membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.
  - B. Align and position Blueskin SA sheet membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps. Promptly roll all laps and membrane with a counter top roller to effect the seal.
  - C. At the end of each days work seal the top edge of the membrane where it meets the substrate using Air-Bloc 21 liquid air seal mastic. Trowel applies a feathered edge to seal termination and shed water.
  - D. Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings. Refer to manufacturers' standard details.
  - E. Ensure all projections, including wall ties, are properly sealed with an application of Air-Bloc 21 liquid air seal mastic.
  - F. Mechanically fasten membrane through securement bars to all window, door, louvers and curtain wall sections as recommended by membrane manufacturer where proper adhesion and bonding cannot be maintained.
  - G. Membrane applied to the underside of substrate surfaces shall receive special attention on application to ensure maximum surface area adhesion is obtained.
  - H. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.

**END OF SECTION 07 25 00**



### **3.5.9 SECTION 07 55 52 – MODIFIED BITUMINOUS PROTECTED MEMBRANE ROOFING**

#### **3.5.9.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Supply and installation of roof waterproofing system to all concrete roof slabs to keep water out of building and to provide thermal insulation.

##### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:

1. Section 072100 - Thermal Insulation
2. All relevant sections in MEP specifications related to Roof Drainage, Plumbing and other service penetrations through the roof.

##### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Damp proofing, and Waterproofing; 2005.
2. ASTM D 312 - Standard Specification for Asphalt Used in Roofing; 2000 (Re-approved 2006).
3. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007.
4. ASTM D 6162 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements; 2000a.
5. ASTM D 6163 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements; 2000.
6. ASTM D 6164 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements; 2005.
7. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.
8. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.
9. UL (RMSD) - Roofing Materials and Systems Directory; Underwriters Laboratories Inc.; current edition.
10. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

##### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's printed specifications and membrane Installation instructions, including methods and materials used for terminations, penetrations, flashing, protection, compatibility and bonding.
- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and other relevant details.



- D. Samples: Submit three samples 300 x 300 mm in size illustrating granule surfaced sheet, insulation, and all other necessary components of the system.
- E. Samples of Aggregate: Submit two 0.5 kg containers of roofing aggregate.
- F. Samples of Pavers: Submit two.
- G. Manufacturer's qualification data.
- H. Installer's qualification data.
- I. Certification:
  - 1. Submit manufacturer's certification/approval for the installer of waterproofing system.
  - 2. Submit manufacturer's certification stating materials supplied are compatible with each other.
- J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Kahramaa's name and registered with manufacturer.

#### **1.5. QUALITY ASSURANCE**

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience and approved by manufacturer.
- D. Substrate condition: Have installer's representative inspect conditions of substrates prior to the application of waterproofing. Rectify conditions as necessary to obtain installer representative's approval.

#### **1.6. DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Store materials in dry area out of direct sunlight and as directed by the materials manufacturers.
- C. Protect foam insulation from direct exposure to sunlight.
- D. Do not use old materials or materials damaged in handling and storage.

#### **1.7. WARRANTY**

- A. See Section 017700 - Closeout Submittals, for additional warranty requirements.
- B. Furnish written warranty of materials and workmanship for the complete water tightness of the Roof.
- C. Correct defective Work within a two year period after Date of Substantial Completion.
- D. Provide five year manufacturer's material and labor warranty to cover failure to prevent penetration of water.

#### **3.5.9.2 PART 2 - PRODUCTS**

##### **1.1. MANUFACTURERS**

- A. Membrane Materials:
  - a. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  - b. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation:



- a. As recommended by waterproofing system manufacturer's recommendation.

#### 1.2. MEMBRANE AND SHEET MATERIALS

- A. Modified elastomeric bituminous membrane with 20% SBS, 5 mm thick with no fillers. The membrane must have a vapour spreading heat resistant sheet underneath to enable free movement of vapor and to facilitate partial bonding.

Subject	Test Method	Unit	Nominal Value
Thickness		mm	4,7
Longitudinal curvature		Mm/5mm	+5
Free deformation	NEN 2091	%	0
Flow temperature	NEN 3643	°C	95
Flow temperature after ageing		°C	85
Cold bending temperature	NEN 2090	°C	-25
Thermal Stability	NEN 2090	°C	-20
Tensile strength at break Length			
Width	NEN 2092	+/- 20%	750 750
	NEN 2092	+/- 20%	
Elongation at break length	NEN 2092	%	750
Elongation at break with	NEN 2092	%	750

#### 1.3. INSULATION

- A. 50mm thk. extruded, rigid board closed cell polystyrene 32-35 kg/m<sup>3</sup> density, thermal conductivity of 0.032 w/m.k.

#### 1.4. BALLAST MATERIALS

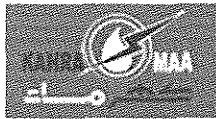
- A. Gravel Ballast: Washed river pebbles, minimum size 20mm.  
B. Tiles: Pre-cast concrete pavers, as indicated in the drawings & finishes schedule.

#### 1.5. ACCESSORIES

- A. Primer: As recommended by the membrane manufacturer and formulated to ensure bonding of the membrane to the substrate.  
B. Sealant: Hot applied SBS sealant, cold applied bituminous or approved equivalent.  
C. Separation layer: Geo-textile separations layer 140 g/m<sup>2</sup> or approved equal.  
D. Metal flashings: 0.9 mm thick aluminium flashings at membrane terminations.

#### 3.5.9.3 PART 3 - EXECUTION

##### 1.1. EXAMINATION



- A. Ensure substrates are dry, clean, smooth, and free of matter and conditions detrimental to bond and performance of the membrane.
- B. Verify that substrate and concrete blinding substrate are smooth, sound and suitable to accept waterproofing.
- C. Ensure all items to be installed by other trades that require penetrations through the waterproofing membrane are placed prior to the application of the membrane.
- D. Verify that light weight screed slopes positively to drains.

#### **1.2. PREPARATION**

##### **A. General:**

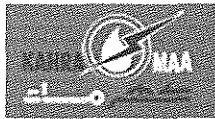
- 1. Comply with membrane manufacturer's instructions for preparation of substrate.
- 2. Sweep substrate as necessary to remove laitance, loose materials, and other contaminants which will have detrimental effect on membrane. Grind smooth all concrete ridges and irregularities.
- 3. Fill voids and cracks in substrate as recommended by membrane manufacturer.
- 4. Prime vertical substrates and other substrates where membrane is to be applied as recommended by membrane manufacturer for optimum adhesion of materials. Allow primer to dry minimum 24 hours before application of the membrane waterproofing.
- 5. All pipe penetrations shall be fitted with an approved pipe sleeve with a welded flange bolted and sealed to structural concrete.
- 6. Groove or approved provision for membrane termination at up stands shall be available.
- 7. All external corners shall be rounded or chamfered. All internal corners shall receive a 40x40 mm mortar fillet.

#### **1.3. INSTALLATION**

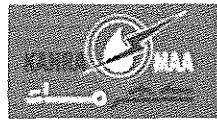
##### **A. Membrane:**

- 1. Install membrane in strict compliance with manufacturer's instructions.
- 2. Apply membrane free of wrinkles and free of wavy edges.
- 3. Apply membrane fully torched onto surfaces as directed by manufacturer except horizontal surface where membrane should be loose laid.
- 4. All lap joints of sheets, to be torched and welded, with 100 mm side laps and end laps fully torched. Apply heat to both sides of the overlaps in proper order and immediately press the overlaps tight.
- 5. Have subcontractor's technical representative thoroughly check all seams. Repair faulty seams.
- 6. For all details of corners, membrane termination, pipe penetration, refer to the technical documents and approved shop drawings and provide reinforcing strips, collars, metal clamps, sealant, etc as required.
- 7. Make watertight seals to all items passing through the membrane such as vent pipes, etc. to overcome any water penetration.

##### **B. Membrane Flashing:**



1. Install membrane flashing in strict compliance with manufacturer's instructions. Bond membrane flashing fully to the substrate. Extend membrane flashings minimum 150 mm out onto the roofing membrane. Extend membrane up vertical surfaces to extent shown. Lap joints of sheets and ensure joints are sealed water and air tight, free of fish mouths and other defects.
  2. Flash items such as pipes and other items passing through membrane watertight.
  3. Flash membrane into drains.
  4. Install fillers around penetrations and fill pocket with no shrink grout and liquid sealer.
- C. Terminations:
1. Provide water cutoffs at end of each day's work.
  2. Pull membrane loose from water cutoff and remove contaminated material before resuming work.
- D. Metal Flashing:
1. Install metal flashings at membrane termination where indicated on the drawings.
  2. Do not install metal flashing until all membrane flashings have been inspected and approved by the Consultant and membrane manufacturer.
  3. Join flashings in a lock-jointed arrangement which will allow for expansion and contraction, faces free from buckling, warp, wave, dents, oil-canning, or other defects.
  4. Provide metal drips, cleats, clips and starter strips as shown or required, of sufficient thickness to hold flashings in true planes and position without deformations.
  5. Where aluminium is in contacts with cementitious materials, coat the back of the aluminium with bituminous paint to prevent corrosion.
- E. Insulation:
1. Place 50 mm thick insulation directly on membrane, tightly butt boards, and stagger end joints. Cut insulation to shape and maintain 12 mm maximum clearance from projections and cant.
- F. Pre-cast Concrete Pavers:
1. Immediately after installation of insulation, loose lay the separation sheet (water pervious fabric) over insulation .Lapping sheets minimum 100mm.
  2. Install pre-cast concrete pavers level on paver's seats or mortar as indicated in drawings with joints butt to moderate contact.
- 1.4 FIELD QUALITY CONTROL**
- A. Membrane manufacturer's representative shall verify warranty requirements are achieved.
  - B. Flood test membrane 24 hours minimum following completion of membrane installation and prior to insulation installation.
  - C. Restrict water runoff from membrane area by plugging drains and creating dams or dikes. Flood restricted area to depth for 24 hours.
  - D. Repair any leaks which develop and retest.
  - E. At completion of flood test, remove drain plugs.
  - F. Coordinate inspection and testing activities described above with the Engineer.
- 1.5 CLEANING**



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- A. Clean stains from adjacent surfaces with cleaning agent.
- B. Remove masking protection, equipment, material, and debris from roof and storage area.

**END OF SECTION 07 55 52**



### **3.5.10 SECTION 07 84 13 – PENETRATION FIRESTOPPING**

#### **3.5.10.1 PART 1 – GENERAL**

##### **1.1. SECTION INCLUDES**

- A. It is the intent of this section of the specifications to establish a single, competent source, unless mentioned otherwise in specific sections, to be responsible for providing all labour, materials, products, equipment and services, to supply and install the fire stopping and smoke seal work for the entire project, all penetrations and interruptions to fire rated assemblies, whether indicated on drawings or not, including the following locations:
1. Openings in fire separations located at fire rated walls, floors and roofs both empty and those containing penetrations such as cables, conduits, cable trays, pipes, ducts and similar penetrating items.
  2. Gaps between fire rated floor slabs and exterior curtain walls.
  3. Gaps between fire rated walls and exterior curtain walls.
  4. Gaps located within expansion joints.
  5. Openings at each floor level in fire rated shafts or stairwells.
  6. Gaps between the tops of fire rated walls and underside of fire rated floor or roof assemblies.
  7. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.

##### **1.2. RELATED WORK**

- A. Openings through Floors and Walls:
3. Fire Rated: Metal sleeves for fire rated openings through floors and walls shall be provided under applicable mechanical and electrical specification sections.
  4. Non-Rated: Non-rated openings through floors and walls shall be sealed under applicable mechanical and electrical specification sections.
- B. Fire stopping and smoke seals within mechanical (i.e. inside ducts, dampers) and electrical assemblies shall be sealed under applicable mechanical and electrical specifications sections and only in accordance with the equipment or device manufacturers' installation instructions. Firestopping and smoke seals around outside of such mechanical and electrical assemblies, where they penetrate fire rated separations, are the responsibility of this section.

##### **1.3. RELATED REQUIREMENTS**

- A. Related requirements as referenced:
1. Civil & Structural Specifications - Cast-in-Place Concrete.
  2. Section 04200 - Unit Masonry Assemblies.
  3. Section 079200 - Joint Sealant.
  4. Façade Specifications - Metal Framed Curtain Wall.
  5. Section 092300 - Gypsum Board Assemblies.
  6. Mechanical Specifications: Mechanical work requiring firestopping.
  7. Electrical Specifications: Electrical work requiring firestopping.



#### 1.4. REFERENCE STANDARDS

- A. Standards of the following as referenced:
  - 1. ANSI/UL 1479 - Fire Tests Of Through-Penetration Firestops.
  - 2. ANSI/UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.
  - 3. ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 4. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2008a.
  - 5. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2006.
  - 6. ASTM E 1399, Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Width of Architectural Joint Systems.
  - 7. ASTM E 2174, Standard Practice for On-Site Inspection of Installed Fire Stops.
  - 8. ASTM E 2307, Standard Test Method for Determining the Fire Endurance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus.
  - 9. CAN4-S115-M85 - Standard Method of Fire Tests of Firestop Systems.
  - 10. Factory Mutual, Approvals Guide.
  - 11. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
  - 12. International Firestop Council Recommended (IFC) Guidelines for Evaluating Firestop Systems Engineering Judgments.
  - 13. NFPA 101 - Life Safety Code.
  - 14. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.
  - 15. ULC, List of Equipment and Materials, Firestop Systems and Components.

#### 1.5. SYSTEM DESCRIPTION

- A. Firestopping Materials: Provide firestopping system(s) of sufficient thickness, width and density to provide and maintain a fire resistance rating, as indicated on drawings and in accordance with UL design numbers applicable for each fire rated assembly.
- B. Provide a seal completely filling all annular spaces to prevent the passage of flame, smoke and gases through the opening in the fire separation in which it is installed.
- C. Material Compatibility: Provide materials which are compatible with all materials used in the system including materials used in or on penetrating items as well as all construction materials used in conjunction or contiguous with the system.
- D. Accessories: Provide components for each firestopping system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire resistance rated systems. Accessories include but are not limited to the following items:
  - 1. Permanent forming/damming/backing materials, temporary forming materials, substrate primers, collars, steel sleeves.

#### 1.6. SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.



B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Manufacturer's Data: Submit manufacturer's specifications, installation instructions and product data for each material required, in accordance with Section 013000. Include UL tested systems or designs to show compliance with the Contract Documents.

D. Shop Drawings: Submit shop drawings showing typical installation details including reinforcement, anchorage, fastenings and method of installation for each type of firestopping condition.

E. Samples: If requested, submit samples of each type of firestopping systems, smoke seals and accessories. Indicate location where material/system shall be utilized.

**1.7. QUALITY ASSURANCE**

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum Ten years documented experience, and having a quality management system that is registered as conforming to the requirements of ISO 9001.

B. Applicator: Company having a minimum of three (3) years experience in the installation of materials specified herein on projects comparable to this project. The firm shall have the written authorization of the firestopping material manufacturer (s).

**1.8. REGULATORY REQUIREMENTS**

A. Conform to applicable local Building Codes for fire resistance ratings.

B. Provide materials, accessories and application procedures which have been listed by UL or tested by a nationally recognized independent testing agency in accordance with ASTM E814 or CAN4-S115 to achieve the required fire protection rating(s).

**1.9. FIELD CONDITIONS**

A. Do not proceed with the installation of firestopping materials when temperatures or weather conditions exceed the manufacturer's recommended limitations for installation.

B. Ventilate solvent based and moisture-cure firestopping per firestopping manufacturer's instructions by natural means or, where this is inadequate, by forced air circulation.

C. Comply with manufacturer's recommended requirements for temperature, relative humidity and substrate moisture content during application and curing of materials.

**1.10. DELIVERY, STORAGE AND HANDLING**

A. Deliver materials to Site in manufacturer's sealed and labelled containers intact. Handle and store materials in accordance with manufacturer's instructions.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

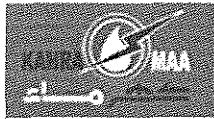
C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.

D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

**1.11. SEQUENCING AND SCHEDULING**

A. Do not install firestopping system(s) until Work within opening has been completed.

B. Coordinate with other applicable Sections.



- C. Schedule work of other trades so that firestopping applications can be inspected prior to being covered by subsequent construction.

### 3.5.10.2 PART 2 - PRODUCTS

#### 1.1. ACCEPTABLE MANUFACTURERS

- A. Provide firestopping silicone sealants, water-based sealants, intumescent sealant, mortars, or firestop devices from any of the following manufacturers:
1. Hilti Inc. - [www.hilti.com](http://www.hilti.com)
    - a. Local Agent: Al Mazrui Engineering Products LLC. P.O.Box 11051, Dubai., UAE.  
T.Ph: 04-8019701, Fax: 04-8854485
  2. Firestopit.com Ltd. - [www.firestopit.com](http://www.firestopit.com)
    - a. Local Agent: Sealant Technology, PO Box 112835, Dubai, UAE.  
T.Ph: 04-285 6907, Fax: 04-285 6906
  3. A/D Fire Protection Systems Inc. - [www.adfire.com](http://www.adfire.com)
    - a. Local Agent: Zanbaq Building Materials, P.O. Box 13604, Dubai, U.A.E.  
T.Ph: 04-2612177, Fax: 04-2616067

B. Or Approved Alternative, comply with Section 016000.

#### 1.2. MATERIALS

- A. Provide a complete system of asbestos-free firestop systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ASTM E814 or CAN4-S115 and listed by UL and in addition are approved by jurisdictional authorities and the Engineer.
- B. Elastomeric Silicone Sealants: For use in: openings with penetrating items subject to high movement; multiple penetration systems; for non-combustible pipes up to 50 mm diameter; in control joints; in curtain wall joints; expansion joints; floor/wall joints; wall/wall joints; head of wall joints; and as a sealant for smoke barrier construction.
- C. Intumescent Caulk: For general use as a firestop sealant with: insulated pipes; combustible pipes upto 75 mm; electrical cables and conduit; ducts.
- D. Firestop mortar: For use in: large openings; static non-moving penetrations such as cable trays; for multiple penetration systems; electrical and communication bundles; conduits; non- combustible sleeves; and insulated pipes.
- E. Firestop collars: For use in openings with single combustible pipe penetrations greater than 75 mm diameter.
- F. Firestop Pillows: For use in openings with: cable tray; multiple cable penetrations; where retrofitting of penetrating items is anticipated; and as a temporary firestop system.
- G. Firestop system ratings: Comply with applicable Building Code requirements for locations and ratings.
- H. Use acrylic based sealants at places with low movement up to 10%.

#### 1.3. ACCESSORIES



- A. Damming and backup materials, supports and anchoring devices: Non-combustible, to manufacturer's recommendations and in accordance with the tested system being installed as acceptable to jurisdictional authorities.
- B. Primers: As required by firestopping manufacturer and compatible with selected system and contiguous materials.
- C. Water: Potable.
- D. Firestopping for vertical (wall) applications: Non-sag (caulk) or spray grade sealants, Mortar, Collars or Pillows.
- E. Firestopping for horizontal (floor) applications: Non-sag (caulk) or self-levelling or spray grade sealants, Mortar, Collars or Pillows.
- F. Firestopping for overhead applications: Non-sag (caulk) or spray grade sealants or Mortar.
- G. Tape: Pressure sensitive masking tape as recommended by the firestopping manufacturer.

#### **3.5.10.3 PART 3 - EXECUTION**

##### **1.1. EXAMINATION**

- A. Examine substrates, openings, voids, adjoining construction and conditions under which the Work is to be installed. Confirm compatibility of surfaces scheduled to receive firestopping.
- B. Verify that penetrating elements are securely fixed and properly located with the proper space allowance between penetrations and surfaces of openings.
- C. Do not proceed with Work until unsatisfactory conditions have been corrected.

##### **1.2. PREPARATION**

- A. Surfaces to receive firestopping shall be free of dirt, dust, grease, oil, rust, loose materials, form release agents, frost, moisture or any other matter which would impair the bond of firestopping material to the substrate of penetrating item(s).
- B. Prime substrates in accordance with manufacturer's written instructions or recommendations. Confine primers to areas of bond; do not allow spillage or migration onto exposed surfaces.
- C. Do not apply firestopping and smoke seals to surfaces previously painted or treated with sealers, curing compounds, water repellent or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- D. Ensure that anchoring devices, back-up materials, clips, sleeves, supports and other related materials used in the actual fire tests are provided.
- E. Mask where necessary to prevent firestopping materials from contacting adjoining surfaces that will remain exposed upon completion of Work. Remove tape as soon as it is possible to do so without disturbing firestopping seal with substrates.
- F. Installation is not to proceed until submittals have been completed.

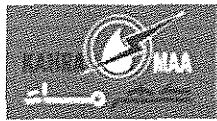
##### **1.3. INSTALLATION**

- A. Manufacturer's Instructions: Comply with UL Listings and manufacturer's instructions for the type of material and condition of opening in each case. Consult with the manufacturer's technical

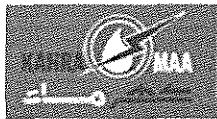


- representative to determine proper procedure for conditions not fully covered by printed instructions. Record in writing any oral instructions received, with copy to manufacturer.
- B. Install firestopping with sufficient pressure to properly fill and seal openings to ensure an effective smoke seal. Tool or trowel exposed surfaces. Remove excess firestopping material promptly as the Work progresses and upon completion.
  - C. Damming: Provide leak-proof dams as required to seal openings and contain liquid sealants, putty or mortar until cured. Install damming in accordance with manufacturer's instructions.
  - D. Damming Boards: Install forming/damming materials and other accessories of type required to support fill materials during their application and in the position needed to produce the shapes and depths required to achieve fire ratings of through-penetration firestop systems.
    - 1. Combustible Type: For temporary dams only. Remove after firestopping material has cured.
    - 2. Non-Combustible Type: For temporary or permanent dams. Provide non-combustible type wherever damming material cannot be removed after applying firestopping materials.
  - E. Void Filler: Use materials recommended by the firestopping manufacturer to seal gaps created by non-combustible type damming boards and to seal around cables, conduits, pipes and where void filler material becomes part of the fire rated assembly.
  - F. Sealant: Install damming material or mineral wool as required. Apply sealant so air voids are not present and sealant is in full contact with penetrating items. Tool sealant to ensure substrate contact. Remove excess sealant in accordance with manufacturer's recommendations.
  - G. Mortar: Install damming material as required. Mix mortar in strict accordance with manufacturers instructions. Pump, trowel or hand pack mortar through openings to minimum thickness as recommended by manufacturer and as listed by UL to achieve required fire rating.
  - H. Firestopping Mineral Wool: Install firestopping by compressing material to the minimum required by UL listing. Apply firestopping in sufficient thickness, depth and density so as to achieve the required fire resistance rating. Use impaling clips support and secure firestopping where required by tested system.
- 1.4 FIELD QUALITY CONTROL**
- A. Notify Engineer when completed installations are ready for inspection prior to concealing or enclosing an area containing firestopping materials.
  - B. Arrange for inspections by the Kahramaa's independent inspection and testing company, appointed and paid for in accordance with Division 1.
  - C. Following field inspections provide all repairs as required to ensure compliance with the Contract Documents.
- 1.5 PROTECTION**
- A. Upon completion of this work, remove all materials, equipment and debris from the site.
  - B. Leave work area and adjacent surfaces in a condition acceptable to the Engineer.
  - C. Leave installed work with sufficient protection to enable it to remain untouched until project handover.

**END OF SECTION 07 84 13**



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### **3.5.11 SECTION 07 92 00 – JOINT SEALANT**

#### **3.5.11.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. This Section includes, but is not limited to, the caulking of joints with sealant in accordance with typical conditions indicated on drawings, as specified herein, and to extent specified in Article 3.5, Caulking Schedule.

##### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:

1. Section 072500 - Weather Barriers: Sealants required in conjunction with air barriers and vapour retarders.
2. Section 078413 – Penetration Firestopping: Firestopping sealants.
3. Section 088000 - Glazing: Glazing sealants and accessories.
4. Section 092613 - Gypsum Board Assemblies: Acoustic sealant.
5. Section 093000 - Tile: Sealant used as tile grout.
6. Section 093033 - Stone Flooring: Sealants used in Stone Flooring

##### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. ASTM C 919 - Standard Practice for Use of Sealants in Acoustical Applications; 2002.
2. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2005.
3. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2005a.
4. ASTM D 1667 - Standard Specification for Flexible Cellular Materials--Poly (Vinyl Chloride) Foam (Closed-Cell); 2005.

##### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, colour availability, and priming and application procedure.
- C. Samples: Submit two samples, 300 X 300 mm in size illustrating sealant colours for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.
- E. Submit the following:
  1. Certification that sealants are compatible with other materials and products with which they come in contact, including but not limited to sealant and caulking provided under other sections, sealant backing materials, insulation adhesives, bitumen, waterproofing, metals and metal finishes and stone.
  2. Certification that sealant is suitable for temperature, humidity and weather conditions at the time of application and under conditions to which it will be subjected during its service life.



3. Certification that sealants have been given extended testing for staining of porous materials and that the manufacturer certifies that staining of materials in contact with sealant will not be caused by sealant system materials.
- 1.5. **QUALITY ASSURANCE**
  - A. Seal joints specified in this section by a firm approved by manufacturers of sealants incorporated; who has equipment, adequate for project, and skilled tradesmen to perform it expeditiously; and is known to have been responsible for satisfactory installations similar to that specified during period of at least the immediate past five years.
  - B. Refer to section 014000 for quality control requirements.
  - C. Test sealants in accordance with BS 3712, or other standard method approved by Engineer.
  - D. Test sealant in contact with samples of materials to be caulked to ensure that proper adhesion will be obtained.
  - E. Test sealants, primer and backing materials to ensure that they will not stain stone or other porous materials with which they are in contact. In addition to accelerated tests if specified in reference standards, make actual tests of sealant materials in contact with porous materials for indication of staining. Allow sufficient time (approximately five months) for stain to appear.
  - F. Test sealant, primer and backing materials to verify that they are compatible with all materials with which they come into contact, and that they will perform to meet specified requirements at each joint condition under environmental conditions experienced at the site.
  - G. Report results to Engineer in writing.
  - H. Applicator Qualifications: Company specializing in performing the work of this section with minimum 5 years experience.
- 1.6. **MOCK-UP**
  - A. Provide mock-up of sealant joints in conjunction with window, wall, air barrier system, and any other locations indicated in the drawings under provisions of Section 01400.
  - B. Construct mock-up with specified sealant types and with other components noted.
  - C. Locate where directed.
  - D. Mock-up may remain as part of the Work.
- 1.7. **FIELD CONDITIONS**
  - A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
  - B. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that encountered at this site, and cause no damage to the products specified in this section or to the performance of these products in use.
  - C. Environmental conditions shall include, but shall not be limited to, ambient temperature; humidity; moisture in the air and on the products and surfaces with which they are in contact; moisture content of the products and materials with which they are in contact; and temperature of the products and the materials with which they are in contact.
  - D. Apply sealants only to completely dry surface
- 1.8. **COORDINATION**



- A. Coordinate the work with all sections referencing this section.
- 1.9. **WARRANTY**
  - A. See Section 017700 - Closeout Submittals, for additional warranty requirements.
  - B. Correct defective work within a five year period after Date of Substantial Completion.
  - C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.
  - D. Include sealant materials and installation under guarantee for waterproofing specified in Conditions of contract. Submit 10 year guarantee to Kahramaa at end of maintenance period.

#### **3.5.11.2 PART 2 - PRODUCTS**

##### **1.1. MATERIALS**

- A. All materials utilized in a sealant system shall be compatible.
- B. Specified proprietary products are minimum acceptable quality.
- C. Selection of sealant by Sub-contractor from specified alternatives shall be made on basis that certification will be provided by the manufacturer as specified for submittals.
- D. Sealants:
  - 1. Provide sealant formulation recommended by manufacturer for type of joint, substrate and service conditions applicable.
  - 2. Refer to Sealant and Caulking Schedule for utilization of the following sealants.
  - 3. Colours of sealants shall match colour of adjacent surface as directed by Engineer.
  - 4. Two Part Urethane Sealant #1 : For use only at interior, to meet specified requirements of FS TT-S-0227E, Type II, Class A, and as recommended by manufacturer for conditions.
    - a. Approved Manufacturers:
      - 1) Dymeric by Tremco Ltd.
      - 2) Nitoseal 625 by Fosroc Ltd.
      - 3) Chem-Calk 500 by Bostik Inc.
    - b. Substitutions: See Section 016000 - Product Requirements.
  - 5. One Part Urethane Sealant # 2 : For use only at interior, to meet specified requirements of FSTT-S-00223OC, Type II, Class A, and as recommended by manufacturer for conditions.
    - a. Approved Manufacturers:
      - 1) Secoseal PU by Fosroc.
      - 2) Nitcoseal HP40 by Fosroc
      - 3) Chem-Calk 900 by Bostik Inc.
    - b. Substitutions: See Section 016000 - Product Requirements.
  - 6. Silicone Sealant: One Part Sealant # 3:
    - a. Manufacturer must furnish certificate to attest sealant will not stain stone surfaces where applicable.
    - b. Low Modulus Type: For use at both exterior and interior, to meet specified requirements of FS TT-S-001543A, Type A or BS 5889 equivalent, and as recommended by manufacturer for conditions. Clear colour for use at interior and exterior structural glazing.



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- c. Approved Manufacturers:
  - 1) Proglaze by Tremco
  - 2) 790 or 795 by Dow Corning
  - 3) Silpurf by General Electric Silicones
  - 4) Nitoseal 125 by Fosroc Ltd
- d. Substitutions: See Section 016000 - Product Requirements.
- 7. Silicone One part Sealant #3A
  - a. Sanitary Type Anti Fungus Type, For use only at interior:
  - b. Approved Manufacturers:
    - 1) 785 by Dow Corning
    - 2) SCS 1700 by GE Silicones
    - 3) Nitoseal 130 by Fosroc
  - c. Substitutions: See Section 01600 - Product Requirements.
- 8. One part Polysulphide Sealant # 4: For use only at interior, to meet specified requirements of FS TT-S-0023C, Type II, or BS 5215, or one part polyurethane movement capacity 20.25%.
  - a. Approved Manufacturers:
    - 1) Chem-Calk 100 by Bostik Inc.
  - b. Substitutions: See Section 016000 - Product Requirements.
- 9. Two Part Polysulphide Sealant # 5: For use only at interior in joints except where subjected to traffic: To meet specified requirements of FS TT-S-00227E, or BS 4254, non-sag, with a Shore "A" hardness range of 20 to 35.
  - a. Approved Manufacturers:
    - 1) Thioflex 600 by Fosroc
    - 2) Chem-Calk 200 by Bostik Inc.
  - b. Substitutions: See Section 01600 - Product Requirements.
- 10. Two Part Polysulphide Sealant # 6 (Grey only): For use only at interior at surfaces subjected to traffic: To meet specified requirements of FS TT-S-02227E, or BS 4254, self-leveling, with a Shore "A" hardness range of 35 to 40.
  - a. Approved Manufacturers:
    - 1) Thioflex 600 by Fosroc
    - 2) Elribbon by PCI Polychemie GmbH
    - 3) Nitoseal 240 3 part Polyurethane coloured by Fosroc
  - b. Substitutions: See Section 016000 - Product Requirements.
- 11. Two parts polyurethane sealant: For use on interior and exterior floor trafficked joints to meet specified requirements of U.S. Federal specification SS-S-200E:1984 and British Standard 5212:1990 - type N, F and FB.
  - a. Approved Manufacturers:
    - 1) Colpor 200PF by Al Gurg Fosroc LLC
    - 2) Dymeric by Tremco Ltd
    - 3) Expoflex 800 by Fosroc Ltd



- b. Substitutions: See Section 016000 - Product Requirements.
- 12. Non hardening acoustical Sealant (Acrylic latex): For use at perimeters and penetrations of Sound rated partitions and walls except for site stopped locations. Acrylic one component.
  - a. Approved Manufacturers:
    - 1) Nitoseal 105 by Al Gurg/Fosroc,
  - b. Substitutions: See Section 016000 - Product Requirements.

## 1.2. ACCESSORIES

- A. Primer:
  - 1. Specifically designed for use with sealant compounds on surfaces encountered, and as recommended and supplied by the compound manufacturer to assure adhesion of compound and to prevent staining of substrate materials.
- B. Joint Cleaner:
  - 1. Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Sealant Backing (Bedding Material)
  - 1. Extruded, foamed, closed cell, round, polyethylene, urethane, neoprene or vinyl rod, 30% greater diameter than joint width, with Shore "A" hardness of 20., and 830 - 900 Kpa tensile strength, manufactured especially for the purpose, and as recommended by sealant manufacturer.
- D. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50% larger than joint width.
- E. Bond Breaker:
  - 1. Pressure sensitive tape recommended by sealant manufacturer to suit application.
- F. Void Filler:
  - 1. Loose glass fiber.
- G. Local Suppliers:
  - 1. The Contractor is permitted to use local suppliers of specified overseas manufactures, for providing miscellaneous chemical material (like admixtures, surface treatments,. Grouts, resin anchors, repair compounds and mortar, flooring products, membranes and sealant, waterstops, adhesives and timber treatment etc.) Subject that products offered meet the requirements of the relevant British Standards or any other approved equivalent standards.

### 3.5.11.3 PART 3 - EXECUTION

#### 1.1. EXAMINATION

- A. Before commencing joint sealing, verify at the site that joint configuration and surfaces have been provided as specified in other sections to met intent of sealant specification; that joint conditions will not adversely affect execution, performance or quality of completed sealed joints; and that they can be put into acceptable condition by means of preparation specified in this section.



- B. Ascertain that sealers and coatings applied to sealant substrates are compatible with the sealant used and that full bond between sealant and substrate is attained. Request samples of the sealed or coated substrate from their fabricators for testing of compatibility and bond if necessary.
- C. Verify that specified environmental conditions are ensured before commencing joint sealing.
- D. Defective sealed joints resulting from application to unsatisfactory joint conditions will be considered the responsibility of this section.

#### **1.2. PREPARATION**

- A. Remove loose mortar, dust, oil, grease, oxidation, mill scale, coatings and all other materials affecting bond of compounds from surfaces to which sealant compounds must adhere, except for painted surfaces, by brushing, scrubbing, scraping or grinding.
- B. Clean down caulked metal surfaces with clean cellulose sponges or rags soaked in solvent recommended by sealant manufacturer, and wipe dry with clean cloths. Ensure that solvent is not injurious to painted surfaces, stone, or other finish materials.
- C. Use methods of preparation suitable for substrate as recommended by sealant manufacturer, and that does not damage adjacent surfaces.
- D. Ensure that releasing agents, coatings or other treatments have either not been applied to joint surfaces, or that they are entirely removed.
- E. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.
- F. Protect elements surrounding the work of this section from damage or disfigurement.

#### **1.3. INSTALLATION**

- A. Except where specified in other sections, seal open joints in surfaces exposed to view, and to make the building weathertight and airtight as applicable; as applicable; as indicated typically on drawings, and as otherwise specified. Refer to Article 3.5. Sealant and Caulking Schedule. Include, but do not restrict it to, sealing the following joints:
  - 1. Except joints of exterior and interior pressed steel opening frames, where installed in masonry and where a weather tight joint is otherwise required.
  - 2. Perimeter joints of exterior and interior aluminium opening frames.
  - 3. Perimeter joints of exterior louver and vent frames.
  - 4. Exposed control joints in masonry walls.
  - 5. Exposed expansion joints in masonry walls.
  - 6. Exposed expansion joints in concrete.
  - 7. Raked joints at masonry wall junctions and masonry to concrete junctions.
  - 8. Interior and exterior exposed joints, between dissimilar materials, and not concealed from view.
  - 9. Joints at top and bottom of pre-cuts concrete stair flights.
  - 10. Joints at bases for roof mounted equipment.
  - 11. Joints between back face of curtain wall and building construction.
  - 12. Joints at wall/floor junctions and at floors only where indicated on drawings.
  - 13. Full length of exterior door saddles.



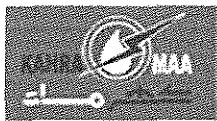
- B. Seal joints to provide an acoustic barrier at locations indicated typically on drawings.
- C. Prime surfaces to receive sealants as required by substrate and manufacturer's specifications to ensure positive and permanent adhesion, and to prevent staining of surfaces adjacent to joints.
- D. Pack joints tightly with sealant backing set at depth specified for sealant. Fill other voids with filler.
- E. Install bond breaker tape in bottom of joints in lieu of sealant backing where proper depth cannot be obtained when backing is installed. Maintain depth of sealant as follows for joint widths of;
  - 1. 6mm (minimum joint width) - joint depth 6mm.
  - 2. 6 to 13mm - Depth equal to joint width.
  - 3. 13 to 25mm - depth equal to one half joint widths.
  - 4. 25 to 50mm - maximum depth of 13mm.
- F. Install sealant in joints over 50mm wide only after consultation with and approval of sealant manufacturer.
- G. Fill joints with sealant compound to specified or indicated depths as indicated. Perform joint sealing in accordance with compound manufacturer's specifications, under his supervision, and using pressure guns and other equipment as approved by him. Finish joints with a full bead so that they are smooth; and free from ridges, wrinkles, air pockets and embedded foreign materials.
- H. Tool surface of joints to a slight concave profile.
- I. Make compounds workable only as manufacturer specifies.
- J. Caulk joints in site painted materials after adjacent surfaces have been painted. Match compound to paint colour.
- K. Do not allow sealants to cover or sport surfaces outside of joints. Use masking tape protection to prevent coating of adjacent surfaces if necessary. Take care to remove masking tape before it becomes backed on the surface.
- L. Install in accordance with ASTM C 962 and manufacturer's instructions unless otherwise indicated.
- M. Do not allow painting or covering of sealed joints unless otherwise indicated on drawings.

#### 1.4. CLEANING

- A. Remove sealant smears and droppings, and masking tape immediately on completion of joint sealing.
- B. Do not use chemicals, scrapers, or other tools which would damage surfaces from which excess compounds of droppings are removed. Make good materials damaged by cleaning by the installer of the damaged material and at the expense of this section.
- C. Instruct Contractor on proper final cleaning methods.

#### 1.5. SCHEDULE

- A. Perform caulking in accordance with this section by:
  - 1. For decorative metal:
    - a. Use low modulus type silicone sealant. One Component- Sealant #3.
  - 2. Façade Specifications for curtain wall system:
    - a. Use low modulus type silicone sealant.



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3. Section 093000 for tile at plumbing fixtures and vanities.
  - a. Use sanitary silicone low modulus sealant anti fungus type Sealant # 3A.
  - b. This section for other joints as required by Article 3.3. Use specified sealant type as recommended by sealant manufacturer and approved by the Engineer.
  - c. This section for sealing of penetrations of exterior walls, fire separations, and separations incorporating constructions to provide low sound transmission that are not sealed under specified work of section 09260, and Divisions 15 and 16.
4. Section 093033 for stone work.
  - a. Use low modulus type silicone sealant. One Component- Sealant # 3.
  - b. For fire rated wall construction: use two-part urethane sealant no.1
5. Section 093033 for exterior horizontal traffic bearing location:
  - a. Use 2 component polyurethane bases Sealant #6.
6. Section 093033 for interior horizontal traffic bearing locations:
  - a. Use 2 component polysulphide Sealant #6 or 2 component polyurethane

**END OF SECTION 07 92 00**



### **3.6 DIVISION 08 OPENINGS**

#### **3.6.1 SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES**

##### **3.6.1.1 PART 1 - GENERAL**

###### **1.1. SECTION INCLUDES**

- A. This section includes, but is not limited to, the following work,
1. Supply and installation of;
    - a. Steel hollow metal doors, transom panels and pressed steel door frames.

###### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:

1. Civil & Structural Specifications- Cast-in-Place Concrete.
2. Section 042000 - Unit Masonry Assemblies.
3. Section 062023 - Finish Carpentry.
4. Section 079000 - Joint Sealers.
5. Section 087100 - Door Hardware.
6. Section 088000 - Glazing.
7. Section 092900 - Gypsum Board Assemblies
8. Section 099000 – Paint & Coatings.
9. Acoustics Specifications – Acoustic requirements

###### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. SDI 100, Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council.
3. ANSI A250.3 - Test Procedure and Acceptance Criteria for Factory-Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
4. ASTM A 36/A36M - Standard Specification for Carbon Structural Steel.
5. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
6. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
7. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
8. ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
9. ASTM D 1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.



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10. ASTM D 1735 - Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus.
  11. ASTM E 2074 - Standard Test Methods for Fire Tests of Door assemblies.
  12. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; the National Association of Architectural Metal Manufacturers.
  13. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers.
  14. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
  15. UL 10B - Standard for Fire Tests of Door Assemblies.
  16. BS 476 - Fire Tests on Building Materials and Structures.
    - a. Part 8 - Test Methods and Criteria for the Fire Resistance of Elements of Building Construction.
  17. BS 729 - Specification for Hot-Dipped Galvanized Coatings on Iron and Steel Articles.
  18. BS EN 1011 - Welding. Recommendations for welding of metallic materials.
  19. Part 1 - General guidance for arc welding.
  20. Part 2 - Arc welding of ferritic steels.
  21. BS 1245 - Specification for Metal Door Frames (Steel).
  22. BS 1449 - Steel Plate, Sheet and Strip. Carbon and carbon-manganese plate, sheet and strip. General specification.
    - a. Part 1 - Specification for Cold Rolled Narrow Strips Based on Specified Minimum Strength.
    - b. Part 2 - Specification for Stainless and Heat Resisting Steel Steel Plate Sheet and Strip.
  23. BS EN ISO 1461 - Hot-Dip Galvanized Coatings on Fabricated Iron and Steel Articles. Specifications and test methods.
  24. BS 5135 - Specification for Arc Welding of Carbon and Carbon Manganese Steels.
  25. BS 7668 - Weldable Structural Steels.
  26. BS EN 10143 - Continuously Hot-Dip Metal Coated Steel Sheet and Strip. Tolerances on dimensions and shape.
- 1.4. SUBMITTALS
- A. See Section 013000 - Administrative Requirements for submittal procedures.
  - B. Shop Drawings. Submit shop drawings showing, details of fabrication, installation, door swings, hardware requirements etc., provisions for security system equipment and wiring.
  - C. Submit four (4) copies of shop drawings for all doors & frames in accordance with instructions of general conditions of specifications. Do not proceed with fabrication prior to receiving final approval from the Engineer.
  - D. Samples.
    1. Submit a sample steel frame and door corner to site.
  - E. Test Reports.
    1. Submit test reports to validate that fire rated doors and frames meet specified fire rating requirements in accordance with UL ratings.
- 1.5. QUALITY ASSURANCE



- A. Qualifications.
  - 1. Provide fabrications specified in this Section only by a firm who has adequate plant, equipment and skilled tradesmen to fabricate it expeditiously and are known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past ten years.
- B. Welder Qualifications.
  - 1. Perform welding of steel structural sections to meet specified requirements of BS 5135 or AWA D1.1.
- C. Requirements for Fire Separation Openings.
  - 1. Construct fire rated doors and frames of ratings indicated in conformance with BS476, Part 8, or NFPA 80 as tested in conformance to ASTM E2074.
  - 2. Validate that doors and frames meet fire rating requirements of Civil Defense Authority.
- 1.6. DELIVERY, STORAGE and PROTECTION
  - A. Store in accordance with NAAMM HMMA 840.
  - B. Brace frame units to prevent distortion in shipment and protect finished surfaces by sturdy protective wrappings.
  - C. Store doors in a secure dry location to ensure that they are not damaged before they are hung. Remove wrappings when finally stored in location secure from damage. Store doors vertically, resting on planks, with blocking between to allow air to circulate.
  - D. Ensure protection for stainless steel surfaces by method that is easily removed without leaving residue or causing damage to the metal surface.
  - E. Repair damage to finishes immediately as it occurs with matching specified finish materials.

#### 3.6.1.2 PART 2 - PRODUCTS

- 1.1. MANUFACTURERS
  - A. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  - B. Substitutions: See Section 016000 - Product Requirements.
- 1.2. MATERIALS
  - A. Steel Sections.
    - 1. Hot rolled steel sections to meet specified requirements of BS 4 Part 1 or BS 7668 as applicable for use, or ASTM A36M.
  - B. Steel Sheet.
    - 1. Cold-rolled, stretcher leveled, to meet specified requirements of BS 1449 Part 1, or ASTM A1008/A 1008M-04a, or SAE Specification 1010.
  - C. Stainless Steel Sheet.
    - 1. AISI Type 304 and Type 316 as indicated or equivalent to meet specified requirements of
    - 2. BS 1449 Part 2, mill stretched and levelled, No. 8 mirror finish
  - D. Galvanizing.



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1. Zinc coated sheet steel, zinc wiped coating to meet specified requirements of BS EN ISO 1461, zinc coating designation G275, or ASTM A653/A653M, zinc coating designation Z275.
  2. Galvanized accessories, hot dip zinc coating to meet specified requirement of BS 729 or ASTM A123.
- E. Door and Frame Insulation.
1. Semi-rigid board, rock-wool mineral fiber, bound by resins, incombustible. With density of 48 kg/m<sup>3</sup> or foamed in place polyurethane foam with nominal in place density of 36.8kg/m<sup>3</sup>. Polystyrene may be used only with the approval of the Engineer.
- 1.3. ACCESSORY MATERIALS
- A. Door Bumpers.
1. Single stud rubber (3 No. for single leaf; 2 No. per leaf for double doors) at interior openings, retained by frame.
- 1.4. FINISH MATERIALS
- A. Prime Paint.
1. Ensure that primers are compatible with specified finish paint. To meet requirements of ASTM B117 Spray Test, ASTM 1735 Fog Test, ASTM D1654 Film Adhesion Test.
  2. Primer. Prime paint for use on galvanized surfaces.
  3. Primer to comply with Spray Test ASTM B117, Fog Test ASTM 1735, Film Adhesion Test ASTM D1654.
  4. Acceptable product:
    - a. Zinc Rich Paint. Galvafroid by Al Gurg Fosroc LLC.
    - b. Or equivalent as approved.
- B. Powder coating. Polyester based to comply with AAMA 2604.
1. Corro-Coat PE SDF Super Durable by Jotun Powder Coatings. b. Or equivalent approved by the Engineer.
- 1.5. FABRICATION
- A. Fabricate frames to specified requirements of BS 1245 or ANSI/SDI 100 Grade 2, Model-2 for doors and frames, to meet requirements of local Civil Defense Authority and as additionally required by this Section.
- B. General.
1. Fit and assemble fabrications in shop where possible. Make trial assembly in shop when not possible.
  2. Fabricate, reinforce and anchor component parts and assemblies to support loads that usage will impose without deflection detrimental to function, appearance or safety.
  3. Reinforce components to resist stresses imposed by hardware in use.
  4. Prepare frames & doors for specified hardware with mortises and reinforcement. Drill and tap to template information. Incorporate steel reinforcement for flush bolts, locks and strikes, panic



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devices, push/pulls, hinges, surface mounted hardware, door closer brackets and arms. Minimum thickness of hardware reinforcing plates shall be as stated in the hollow metal manufacturer's association guide specification HMMA 861-00.

5. Install metal mortar guards of minimum 0.76mm thick steel at cutouts for hardware in frames installed in masonry walls.
6. Reinforce all frames for closers.
7. Provide for anticipated expansion and contraction of frames and supports.
8. Fit elements at intersections and joints accurately together, in true planes and plumb and level.
9. Weld frame and door assemblies together. Weld continuously at joints exposed to view and at joints through which air or water could penetrate from the exterior of building to the interior.
10. Where welding is impossible, connections may be bolted. Ream drilled holes and leave exposed edges clean and smooth.
11. Isolate from each other dissimilar metals and metal from concrete or masonry to prevent electrolysis.
12. Make provisions as required in frames and doors for installation of security system equipment, hardware and wiring.

**C. Stainless Steel Fabrication.**

1. Fabricate components incorporating stainless steel exposed to view with the rolling direction the same for each component type throughout.
2. Isolate fabrication of stainless steel from other areas where carbon steel is worked to ensure that no carbon steel dust is embedded into stainless steel.
3. Use tools and dies which have been used on carbon steels only after they have been thoroughly cleaned.
4. Do not cut or form stainless steel with tools or dies that are nickel or damaged.
5. Ensure that backup of stainless steel will maintain or improve specified flatness without telegraphing of fasteners and similar distortions.
6. Doors and frames indicated as stainless steel in the Door Schedule shall be mirror No. 8 (polished) finish. Stainless steel, fire-rated doors shall be stainless steel, complete both sides, with required ULI label or approved equal.

**D. Pressed Steel Door Frames.**

1. Fabricate frames of zinc coated (galvanized) sheet steel and of stainless steel sheet at indicated locations.
2. Fabricate frames in minimum thickness of 1.6mm sheet unless otherwise specified or indicated. Double door frames 1.91mm thick.
3. Use 2.0mm thick sheet for exterior frames and interior frames over 2151mm high.
4. Minimum frame material thickness applies only to doors not otherwise requiring heavier gauges to meet specified fire rated construction as required by validating test.



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5. Reinforce head of frames for double door openings.
6. Fabricate removable stops of minimum 0.91mm thick steel. Do not weld stop corners.
7. Where members join at corners, cut miters and weld continuously along inside of sections.
8. Attach two 1.2mm thick steel channel spreaders at bottom of door frames to maintain square alignment, secured to facilitate removal after frames that extend only to finish floor are built in.
9. Incorporate structural stiffeners for frame members as shown on Drawings. Securely anchor them at bottom and top. Where they extend above ceiling anchor them to concrete or structural framing to suit site conditions.
10. Install three bumpers in interior frames at single opening latch jambs and two at double door frame heads.
11. Fasten removable stops by countersunk Philips head screws at approximately 225mm on centre symmetrically spaced on stop length.
12. Anchor frames to floor by 1.5mm thick angle clips, welded to frame and provided with two holes for floor anchorage.
13. For frames in masonry walls, attach adjustable Tee-anchors fabricated of galvanized steel in same gauge as frame. Install anchors on each jamb. Install three anchors for openings up to 2200mm high. Install four anchors for openings from 2200mm to 2400mm high.
14. For frames in stud walls, weld or securely wedge 1.2mm thick steel anchors to inside of frame jambs. Install anchors on each jamb. Install four anchors for openings up to 2285mm high. Install five anchors for openings from 2285mm to 2440mm high.
15. Finish frames with one coat of galvanized primer on zinc coated surfaces exposed to view.

**E. Steel Doors and Panels.**

1. Fabricate doors 45mm thick.
2. Openings in exterior walls and where acoustic seal is installed.
  - a. Fabricate of hollow steel seamless construction with each face formed from one sheet of flush 1.6mm thick steel sheet. Weld and dress longitudinal joints. Door seam is to be continuous welded and ground smooth. Plastic, liquid or putty filling of smooth seamless and unbroken surfaces with top edge closed flush and welded to both door faces, with inverted closed bottom. Construct doors with vertical 0.91mm thick steel stiffeners and 1.2mm thick top and bottom channels, spot welded to face sheets at 150mm on centre maximum. Fill all voids with door insulation.
2. Openings in interior of buildings.
  - a. Fabricate as specified in previous sub-paragraph or of composite metal face construction with each face formed from one sheet of flush 1.6mm thick steel sheet. Weld and dress longitudinal joints. Construct doors with honeycomb core material laminated under pressure to face sheets and to fill core space completely. Close tops and bottoms of doors with 1.2mm thick recessed steel channels spot welded to face sheets.



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3. Minimum panel thickness and type of construction applies only to doors not otherwise requiring heavier gauges or different construction to meet specified fire rated construction.
4. Fabricate doors of zinc coated (galvanized) sheet steel. Where stainless steel face is indicated bond stainless steel sheet fully to face and edges of doors and frames.
5. Provide doors with 3mm clearance at heads and jambs and no more than 19mm at floors. Provide clearance at floor with allowance made for intended finish flooring.
6. Bevel edges of stiles to suit door swing.
7. Fabricate metal panels installed with doors in the same opening the same as for the doors.
8. Locate hardware to ANSI recommended standards unless shown otherwise on Drawings or Door Schedule. Construct doors and frames with special internal reinforcing, conduit to accept magnetic locks strikes and other electrical devices
9. Fabricate removable stops of minimum 0.91mm thick steel.
10. Prepare doors to receive glass and stops. Secure removable stops with counter-sunk Philips head screws at approximately 450mm on centre, 50mm from each end and symmetrically spaced on stop lengths.
11. Close top and bottom edges of exterior doors with sheet steel caps so that they are flush with face edges.
12. Fabricate closing stiles of paired doors and to receive hardware as detailed on Drawings or Door Schedule.
13. Finish doors with one coat of galvanized primer on zinc coated surfaces exposed to view.
14. Core. As per standards and ULC or ULI requirements for labelled doors. Foamed in place polyurethane foam at sound rated doors, sufficient density to provide satisfactory structural support and sound reduction characteristics of 32 decibels at average frequencies of 125 to 4000. Exterior doors, rigid polyurethane. Polystyrene may be used only on approval of the Engineer and Kahramaa.
15. Fire-rated Doors and Frames. Mineral or semi-rigid glass fiber insulation having min. density of 48.6kg/m<sup>3</sup> or calcium silicate to meet requirements of ULC or ULI as applicable. Temperature Rise Rated (TRR) cores; composition to limit temperature rise on unexposed side of door to 250°C at 30 or 60 minutes, as determined by governing building code requirements. Provide TTR fire rated door and frame assemblies in vertical exit enclosures and exit passageways in accordance with the International Building Code (IBC).

**F. Access Doors.**

1. Fabricate four-sided frames as specified in this Section for pressed steel door frames.
2. Fabricate doors as specified in this Section.

**1.6. FINISHING**

- A. File and grind exposed welds smooth so that assemblies have appearance of one piece construction. At steel surfaces fill depressions with metal fillet and finish smooth. At stainless steel polish joints to match adjacent surfaces.



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- B. For surfaces with zinc coating, clean and smooth ground surfaces at welds, fill if necessary and coat all areas from which galvanizing has been removed with two coats of zinc rich paint, each 0.025mm thick, immediately following damage to galvanized protection. Prepare and repair surfaces to meet specified requirements of ASTM Specification A780.
- C. For prime painted galvanized surfaces, clean surfaces to completely remove oil, grease passivation treatments and other foreign deposits. Ensure that damaged zinc coating has been coated with zinc rich paint and finished smooth. Apply smooth full coat of low VOC minimum 81% organic zinc rich primer in shop.
- D. All Door components to be finished with Powder coating. Polyester based to comply with AAMA 2604.

### 3.6.1.3 PART 3 - EXECUTION

#### 1.1. EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

#### 1.2. INSTALLATION

- A. Pressed Steel Frames.
  - 1. Setting up of pressed steel frames in masonry walls is included in Section 062023.
  - 2. Setting up and building in of pressed steel frames in metal stud gypsum board partitions is included in Section 092900.
  - 3. Secure frames to floor construction with two fasteners at each jamb and set and brace them securely to maintain true alignment until built in.
- B. Jambs at Tempered Glass Screens.
  - 1. Secure jambs to concrete at top and bottom by galvanized steel bolts in expansion shields
- C. Doors.
  - 1. Install doors only when construction has progressed to a stage when no damage will occur to them in place.
  - 2. Hang doors to swing easily and freely on their hinges, to remain stationary in any position
  - 3. and to close tightly and evenly on frames without binding.
  - 4. Installation of doors supplied by this Section and finish hardware supplied by Section
  - 5. 087100 is included in Section 062023.
  - 6. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
  - 7. In addition, install fire rated units in accordance with NFPA 80.
  - 8. Coordinate frame anchor placement with wall construction.
  - 9. Coordinate installation of hardware.
  - 10. Coordinate installation of glazing.
  - 11. Touch up damaged factory finishes.



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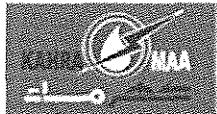
**1.3. TOLERANCES**

- A. Fabricate and install work of this Section where exposed to view to maintain a surface flatness which ensures that the slope of the surface at any point is no greater than 0.5% from the nominal plane of the surface when measured at 25mm intervals in any directions on flat planes or on line normal to longitudinal axis of cylindrical surfaces, under any combination of performance conditions.

**1.4. ADJUSTING AND CLEANING**

- A. Adjust for smooth and balanced door movement.
- B. Clean surface in preparation for specified finishing at completion of installation.

**END OF SECTION 08 11 13**



### **3.6.2 SECTION 08 12 16 - ALUMINUM DOORS AND FRAMES**

#### **3.6.2.1 PART 1 – GENERAL**

##### **1.1. SECTION INCLUDES**

- A. This Section includes, but is not limited to, the following work;
1. Supply and installation of aluminium framed glazed screens, doors and door frames including partition as indicated on the drawings.
  2. Glazing of aluminium framed screens and doors.
  3. Sealing between systems specified in this Section and abutting surfaces.

##### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:

1. Civil & Structural Specifications- Cast-in-Place Concrete.
2. Section 042000 - Unit Masonry Assemblies.
3. Section 062000 - Finish Carpentry.
4. Section 079000 - Joint Sealers.
5. Section 087100 - Door Hardware.
6. Section 088000 - Glazing.
7. Section 092400 - Portland cement Plaster.
8. Section 099000 - Paints and Coatings.
9. Acoustics Specifications – acoustic requirements

##### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. AAMA 605.2 - Voluntary Specification for High Performance Organic Coatings on Architectural aluminium Extrusions and Panels.
2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; American Architectural Manufacturers Association; 2002.
3. ASTM A 36/A36M - Standard Specification for Carbon Structural Steel.
4. AWS D1.2/D1.2M - Structural Welding Code - Aluminium.
5. BS 1470 - Specification for wrought aluminium and aluminium alloys for general engineering purposes - plate, sheet and sheet and strip.
6. BS 1471 - Specification for wrought aluminium and aluminium alloys for general engineering purposes - drawn tube.
7. BS 1473 - Specification for wrought aluminium and aluminium alloys for general engineering purposes - rivet, bolt and screw stock.
8. BS 1474 - Specification for wrought aluminium and aluminium alloys for general engineering purposes - bars, extruded round tube and sections.
9. BS 2571 - Specification for flexible PVC compounds.



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10. BS 3416 - Specification for black bitumen coating solutions for cold application.
  11. BS 3571-1 - MIG Welding. Specification for MIG welding of aluminium and aluminium alloys.
  12. BS 4360 - Specification for weldable structural steels.
  13. BS 4848 - Specification for hot-rolled structural steel sections.
    - a. Part 2 -Hollow Sections.
    - b. Part 4 - Equal and unequal angles.
  14. BS 4871 - Specification for approval testing of welders working to approved welding procedures.
    - a. Part 2 - TIG or MIG welding of aluminium and its alloys.
  15. BS 5135 - Specification for process of arc welding of carbon and carbon manganese steels.
  16. GANA (GM) - GANA Glazing Manual, Glass Association of North America.
  17. GANA (SM) - FGMA Sealant Manual, Glass Association of North America.
- 1.4. SUBMITTALS**
- A. See Section 013000- Administrative Requirements, for submittal procedures.
- B. Shop Drawings
1. Submit shop drawings showing and describing in detail system assemblies, including, large scale details of members and materials, of brackets and anchorage devices and of connection and jointing details, fully dimensioned layout for positioning of brackets and anchorage devices to structures, dimensions, gauges, thicknesses glazing details, descriptions of materials, including catalogue numbers, products and manufacturers' names, aluminium alloy and temper designations, metal finishing specifications and other pertinent data and information.
- C. Samples.
1. Submit samples of unit frame profiles and glass, 300mm x 300mm size, prior to fabrication of units. Sample acceptance will be for profile, appearance and glazing detail only. Compliance with other requirements is the responsibility of the Contractor.
  2. Submit samples for each finish and colour required. Submit samples finished on the specified alloy on 300mm lengths of extrusions or 300mm square of sheet or plate, showing maximum range or variation in texture, colour and shade. Sample submittal and acceptance shall be for colour and texture.
  3. Submit samples of architectural coating finish to Engineer Office.
- 1.5. QUALITY ASSURANCE**
- A. Manufacturer Qualifications. Not less than 5 years of experience in manufacturing components of the types specified.
- B. Glazing Requirements
1. Conform to recommendations of GANA Glazing Manual (GM) and FGMA Glazing Sealing Manual (SM).
- C. Qualifications
1. Provide systems specified in this Section only by a fabricator and erector who has adequate plant, equipment and skilled tradesmen to perform it expeditiously and is known to have been



responsible for satisfactory installations similar to that specified during a period of at least the immediate past ten years.

**D. Welder Qualifications**

1. Perform welding of structural components to meet specified requirements of BS 5135 for welding of steel and BS 3571-1 for welding of aluminium, or of AWS D1.1 for steel and AWS D1.2 for aluminium

**1.6. MOCK-UP**

**A. Mock-up of Glazed Screen and Door**

1. Construct a full size mock-up at the building including one door opening with a door and a minimum of two full glazed panels.
2. Installation of mock-up shall be supervised by the superintendent who will be assigned for the total installation.
3. Protect mock-up from damage. Remove protection only at completion of the Works.
4. When approved, mock-up will provide the standard by which total installation will be judged.
5. All materials used for mock-up panels must be in complete accordance with the specification and approved samples and details. Mock-up will be the basis for all comparison of workmanship and materials.
6. Mock-up shall be corrected, replaced, adjusted or made good to the Engineer satisfaction and at no cost to Kahramaa.
7. When mock-up is approved by the Engineer, it may become part of the permanent structure.

**1.7. DELIVERY, STORAGE and HANDLING**

- A. Deliver aluminium components in manufacturer's standard protective packaging, palleted, crated, or banded together.
- B. Inspect delivered components for damage and replace. Repaired components will not be accepted.
- C. Store components under cover in manufacturer's packaging until installation.
- D. Deliver work of this Section to site as required for installation, to meet construction schedule and to locations as directed.
  1. Cross-brace large units. Package or crate units for shipment and storage before installation.
  2. Store products clear of grade, protected from damage and as recommended by manufacturer.
  3. Protect finish surfaces by sturdy protective wrappings.
  4. Provide methods for lifting units into place without causing damage.
  5. Do not permit foreign materials such as splashing of concrete, mortar, plaster or paint, which could damage the finish, to remain on the surface of metalwork. All materials of this nature must be immediately removed. Protect exposed surfaces of metal exposed to abuse by removable vinyl or other suitable and approved protection throughout the period that work proceeds on the building. Remove protective materials carefully on completion of the works and in such a manner that no damage occurs to the metal finish.

**1.8. FIELD CONDITIONS**



- A. Determine interfacing required between systems specified in this Section and the building structure to ensure adequate anchorage of work and that loads carried by the structure are not transmitted to screens.
- B. Provide for expansion and contraction of all parts for a building interior temperature range from 10°C to 45°C. Movement from temperature fluctuations shall not displace, twist, distort or buckle any part of a system specified in this Section or the structure to which it is attached. Movement shall be absorbed into freely functioning expansion and contraction joints and fastenings.

### 3.6.2.2 PART 2 - PRODUCTS

#### 1.1. MANUFACTURERS

- A. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
- B. Substitutions: See Section 016000 - Product Requirements.

#### 1.2. MATERIALS

##### A. Aluminium.

- 1. Extrusions. To meet specified requirements of BS 1470, BS 1471 and BS 1474 as applicable or AA 6063-T5, alloy and temper for framing and otherwise where not exposed to suit specified and fabricator's requirements.
- 2. Sheets. To meet specified requirements of BS 1470, or of AA 1100-H14, alloy and temper where exposed and AA 3003-H14, alloy and temper, mill finish, where concealed from view.
- 3. Exposed surfaces of aluminium shall be free of die marks, scratches, blisters, "leave-off" marks, or other blemishes which are visible.

##### B. Steel Framing.

- 1. To meet specified requirements of BS 4 Part 1, or BS 1449 Part 1, or BS 4848, Part 2 or Part 4, as applicable or of ASTM A36/A36M.

#### 1.3. COMPONENTS

##### A. Door Insulation.

- 1. Semi-rigid board, rockwool mineral fibre, bound by resins, incombustible, with density of 48 kg/cu.m.

##### B. Glass.

- 1. Types as indicated in the drawings, Glazing Schedule and Specification Section 088000.

##### C. Glazing Materials

- 1. To meet specified requirements of Section 088000.

#### 1.4. GLAZED SCREENS

##### A. Framing Members.

- 1. Extruded aluminium minimum 1.5 mm thick, if required for the stability of the frame.
- 2. Provide welded steel reinforcing members within aluminium framing as indicated on drawings.



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3. Provide continuous door gaskets secured to door stops in a manner that replacement may be made without special tools.
- B. Glass
1. Refer Glazing Schedule and Product Schedule for information.
- 1.5. HINGED DOORS
- A. Hardware.
1. Supplied under work specified in Section 087100.
- B. Support Framing.
1. It is the responsibility of this Section to clearly furnish framing as necessary and to install support framing in a structurally adequate manner, to be stressed not more than published working stress of material used under anticipated maximum load conditions.
- 1.6. FINISHES
- A. Aluminium Finish.
1. Organic Coating. Thermosetting fluorocarbon polymer (polyvinylidene fluoride) based coating incorporating Kynar 500 by;
    - a. Pennwalt Corporation
    - b. Colour will be selected from manufacturer's custom range by Engineer.
  2. Powder coating. Polyester based to comply with AAMA 2604.
    - a. Corro-Coat PE-SDF Super Durable by Jotun Powder Coatings.
    - b. Or equivalent approved by the Engineer.
- 1.7. ACCESSORIES
- A. Bituminous Paint.
1. Black solvent carried bituminous paint, to meet specified requirements of BS 3416, Type 1.
- B. Supporting angles, plates, bars, rods and other steel accessories.
1. Steel to meet specified requirements of BS 4 Part 1, BS 1449 Part 1, BS 4360 and BS 4848 Parts 2 and 4, as applicable, or of ASTM A36/A36M, hot dip galvanized after fabrication, size and thickness as required to sustain imposed loads and in no case less than 4.8mm thick.
- C. Anchors.
1. Austenitic AISI Type 300 stainless steel with aluminium materials and otherwise to match metal anchored.
- D. Door Gaskets.
1. Preformed PVC.
- E. Fastenings.
1. Stainless steel, austenitic AISI type 300 series.
- F. Sealants and Sealant Materials
1. To meet specified requirements of Section 079000.

### 3.6.2.3 PART 3 - EXECUTION



### 1.1. FABRICATION

#### A. General.

1. Conceal all fasteners except as required for functioning hardware.
2. Provide for security system installations specified in Section 087100.
3. Ensure that glazing rebate is provided with depth and width to accommodate specified glass in accordance with glass manufacturer's recommendations. Install glazing gaskets anchored to aluminium extrusions

#### B. Framing Members.

1. Fabricate generally to dimensions and profiles indicated on drawings and to meet specified requirements. Maintain sight lines indicated and clearances to other construction components.
2. Reinforce members and joints with steel plates, bars, rods or angles for rigidity and strength as indicated and as required to fulfill performance requirements.
3. Provide glass setting, supports and stops to minimize possibility of glass breakage caused by structural inadequacy of frames and as recommended by glass manufacturer.

#### C. Assembly of Units.

1. Join members by welding generally.
2. Conceal welding where required so as not to produce any bloom effect on finished surface.
3. Join members where welding is impracticable, by mechanical methods. Reinforcement of fasteners visible on faces of members where exposed to view will not be acceptable.
4. Weld with electrodes and by methods recommended by the base metal manufacturer and in accordance with specified requirements and to avoid distortion or discolouration of exposed faces. Make welds continuous unless otherwise indicated. Grind exposed welds flush to match adjacent metal.
5. Accurately fabricate and fit all components in the shop where possible.
6. Join members in shop fabricated units to fit flush with hairline joints, splined or otherwise backed up to reinforce.
7. Except where shipping makes impossible, fabricate units in shop and ship completely assembled. Make trial assembly in shop of assemblies shipped in sections.

#### D. Support Framing.

1. Fabricate support framing of welded galvanized hot rolled steel members.

#### E. Galvanized Steel.

1. Hot dip galvanize assemblies following their fabrication except where impossible.
2. Paint galvanized surfaces that are cut, welded or threaded with zinc rich paint to ensure a minimum coating of 0.102mm, immediately following damage to galvanized protection. Prepare and repair surfaces to meet specified requirements of ASTM A 780.

#### F. Aluminium Organic Coating Finish.

1. Pretreat aluminium and provide primer and finish coats in accordance with AAMA 605.2
2. Primer Coat. 0.0075mm thick.
3. Finish Coat. Minimum 0.508mm thick.



- G. Fastenings.
    - 1. Use stainless steel fastenings for aluminium.
    - 2. Use galvanized steel fastenings for steel support framing.
  - H. Dissimilar Materials.
    - 1. Protect material from electrolytic action when dissimilar metals are in contact with one another.
    - 2. Protect aluminium concealed in contact with masonry with a heavy coating of bituminous paint.
  - I. Anchors.
    - 1. Incorporate anchorage to structure to support work adequately when subjected to loads imposed by use.
    - 2. Allow for complete adjustment in anchorage for leveling and positioning of work during installation.
  - J. Attachment of Hardware.
    - 1. Provide for attachment of hardware supplied by section 087100 in accordance with template information.
    - 2. Provide for attachment of hardware by bolts or machine screws into tapped reinforcing plates.
- 1.2. EXAMINATION**
- A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.
  - B. Verify that frames installed by other trades for installation of doors of this section are in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.
- 1.3. PREPARATION**
- A. Perform cutting, fitting, forming, drilling and grinding of frames as required for project conditions.
  - B. Replace components with damage to exposed finishes.
  - C. Separate dissimilar metals to prevent electrolytic action between metals.
- 1.4. COORDINATION**
- A. Coordinate with other sections to ensure that provisions are made for and that connections are made by this section, to provide installation as specified.
- 1.5. INSTALLATION**
- A. General.
    - 1. Coordinate fabrication of components specified in this section with requirements of other sections to ensure permanent anchorage and fitting.
    - 2. Install components and units plumb, level and in accordance with shop drawings, by qualified experienced tradesmen and to conform to fabricator's instructions.
    - 3. Do not force units into place, nor superimpose on them loads for which they were not designed.
    - 4. Provide for thermal movement to take place throughout entire specified temperature range between shop fabricated assemblies and between assemblies and adjacent construction.



5. Secure units by non-corrosive anchorage materials. Use of wood or fiber is not acceptable.
  6. Conceal anchors, clips, blocking and all other attachments.
  7. Install reinforcing and supporting members as indicated and required structurally as part of the work of this section.
  8. Install units with consideration for finish variations. Abrupt variations of appearance or colour in adjacent components will not be acceptable without approval before installation.
- B. Support Framing.
1. Install support framing anchored to structure by expansion shields and bolts.
  2. Provide bracing to ensure lateral stability of framing
- C. Welding.
1. Perform welding in accordance with specified requirements. Exercise care during welding to minimize effect of welding heat. Design welds to prevent a tearing at end of welds which could cause a progressive failure.
  2. Detailed welding procedure covering specified welds on erection and shop drawings may be requested for approval by the Engineer.
  3. Take precautions during welding to prevent damage or staining of adjacent surfaces.
- D. Caulking
1. Caulk joints between frame members and adjacent construction.
  2. Perform caulking incorporated with work of this section to meet specified requirements of section 079200 of the specification.
- E. Glazing
1. Install glass in units, as a part of work of this section and to meet specified requirements of section 088000 of the specification.
- 1.6. TOLERANCES
- A. Fabricate work of this section to a tolerance of + 1.5mm for vertical, horizontal and diagonal dimensions of units under 1830mm and + 3mm for dimensions greater than 1830mm.
1. Erect component parts within following tolerances;
    - a. Variations from plumb and level, 2mm maximum variation in height or 3m run, non-cumulative.
    - b. Variations from theoretical calculated plan or elevation location related to established floor lines, column lines and other fixed elements of the structure, including variations for plumb and level, 6mm maximum variation in any column-to-column space, floor- to-floor height, or 6m run.
    - c. Offsets in end-to-end or edge-to-edge alignment of adjoining members, 0.5mm maximum offset in any alignment.
  2. Fabricate and install work of this section where exposed to view to maintain a surface flatness which ensures that the slope of the surface at any point is no greater than 0.5% from the nominal plane of the surface when measured at 25mm intervals in any direction of flat planes or on line normal to longitudinal axis of cylindrical surfaces, under any combination of



performance conditions. Surfaces shall be accurately formed and designed to be free of any oil canning and distortions, pitting, discolouration, weld, halo or other imperfections on exposed surfaces.

3. Maintain tolerance for glazing as recommended by glass manufacturer.
4. Deviation from flatness (overall bow and warpage) of tempered glass surfaces shall not exceed the following dimensions;

#### 1.7. CLEANING

##### A. Cleaning on Completion of Installation.

1. Remove deposits which affect appearance of units.
2. Remove protective materials.
3. Clean interior and exterior surfaces of metal and glass as per glass manufacturer's / supplier's recommendations by washing with clear water, or with water and soap or detergent, followed by a clear water rinse.
4. Clean and restore stained metal surfaces in accordance with manufacturer's recommendations. Replace if cleaning is impossible.

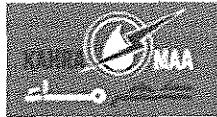
#### 1.8. ADJUSTMENT

- A. Adjust doors to operate smoothly and fit tightly when closed and locked.
- B. Adjust hardware to operate smoothly, with proper tension and lubricate.
- C. Adjust closers after doors are glazed.
- D. Repair areas of bare metal and welds on galvanized surfaces with zinc rich paint.
- E. Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.
- F. Refinish shop applied finishes in field only with approval.

#### 1.9. PROTECTION

- A. Protect pre-finished surfaces of metal work with protective coatings or wrappings to remain in place until construction completion. Use materials recommended by finishers or manufacturers of metals to ensure that method is sufficiently protective, easily removed and harmless to finish.
- B. Remove protection from metal glazing surfaces before installation of glass.
- C. Maintain protection from time of installation to final cleanup.
- D. Protect products of this Section from damage caused by subsequent construction until substantial completion.
- E. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

**END OF SECTION 08 12 16**



### **3.6.3 SECTION 08 14 16 – FLUSH WOOD DOORS**

#### **3.6.3.1 PART 1 – GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Flush wood doors; flush configuration; fire rated, non-rated, and acoustical.
- B. Transom panels.

##### **1.2. RELATED REQUIREMENTS**

- A. Related requirements as referenced:

1. Section 062023 - Finish Carpentry.
2. Section 081113 - Hollow Metal Doors and Frames.
3. Section 087100 - Door Hardware.
4. Section 088000 - Glazing.
5. Section 099000 – Paints and Coatings.
6. Acoustics Specifications – acoustic requirements

##### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:

1. ANSI A208.1 - American National Standard for Particleboard.
2. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. WDMA NWWDA I.S.1-A - Architectural Wood Flush Doors; Window and Door Manufacturers Association (formerly NWWDA).
4. BS EN 438:1 - Decorative high-pressure laminates (HPL) sheets based on thermosetting resins. Specifications.
5. BS EN 438:2 - Decorative high-pressure laminates (HPL) sheets based on thermosetting resins. Determination of properties.
6. BS EN 951 - Door leaves. Method for measurement of height, width, thickness and squareness.
7. BS 3794 - Decorative laminated sheets based on thermosetting resins. Specification.
8. BS 4787:1 - Internal and external wood door sets, door leaves and frames. Specification for dimensional requirements
9. BS 4965 - Decorative laminated plastics sheet veneered boards and panels.
10. BS 5277 EN 24 - Doors. Measurement of defects of general flatness of door leaves.

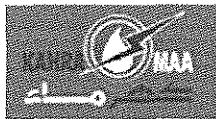
##### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Shop Drawings.

1. Submit shop drawings of each door type showing details of fabrication, installation requirements, door swings, hardware requirement etc. including provisions for security system and wiring and including schedule.

- C. Samples.



1. Submit 300mm x 300mm samples of each type of door and frame to site and to the Engineer Office.  
Sample of frame to show screw and plug at typical anchor.

2. Samples shall be complete with stain and finish to the approval of the Engineer and Kahramaa.

**1.5. QUALITY ASSURANCE**

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer. Company specializing in manufacturing the products specified in this section with minimum 10 years of documented experience and who has adequate plant and skilled tradesmen to perform it expeditiously.

**1.6. DELIVERY, STORAGE & PROTECTION**

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.
- D. Store doors flat in air-conditioned space at site in piles with bottom face on bottom of piles protected from moisture by water resistant material under skids supporting piles, top of piles covered and air circulation provided at sides of piles.

**1.7. PROJECT CONDITIONS**

- A. Coordinate the work with door opening construction, door frame and door hardware installation.
- B. Environmental Conditions.
  1. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site and cause no damage to the products specified in this section or to the performance of these production use.
  2. Follow recommendations of the supplier of the products.
  3. Environmental conditions shall include, but shall not be limited to, ambient temperature, humidity, moisture in the air and on the products and surfaces with which they are in contact, moisture content and temperature of the products and the materials with which they are in contact.

**1.8. WARRANTY**

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide warranty for the following term;
  1. Interior Doors, one year
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, and defective materials.

**3.6.3.2 PART 2 - PRODUCTS**

**1.1 DOORS AND PANELS**

- A. All Doors. See drawings for locations and additional requirements.



- B. To meet Premium Quality Standard of AWI, Section 013000, for interior doors, AWI Spec. Symbol B stile and rail solid core type, with I.S. Premium Grade faces where lacquered or stained and I.S. Good Grade faces where painted.
- C. The Contractor is permitted to fabricate doors meeting the relevant British Standards instead of AWI - Architectural Woodwork Quality Standards and Guide Specifications.
- D. Transom Panels. Same construction and finish as door, same performance rating as door.

#### 1.2. DOOR AND PANEL CORES

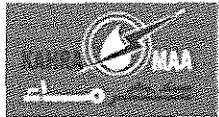
- A. Cores of Flush Doors. Solid Wood Cores.

#### 1.3. DOOR FACINGS

- A. Wood Veneer Facing.
  - 1. AWI premium grade quarter cut slip matched, grade A 10.7mm thick carefully selected for grain pattern and uniform colour, free of dark stains, blemishes and sugar markings. Hardwood veneer shall be sound with no open defects. Final colour and figure of the hardwood veneer shall be selected by the Engineer.
  - 2. 1 coat vinyl sealer. 1 coat colour pigmented interior wood stain and 2 coats medium/low sheen type catalyzed lacquer finish to the approval of the Engineer and submitted samples.
  - 3. Solid wood cores, wood rails and stiles. Softwood, kiln dried to a minimum of 5% and maximum of 7% moisture content.
- B. Frames - (with veneered doors).
  - 1. Solid hardwood, mortise and tenon joints as shown on drawings. Matching veneer on doors finished with 1 coat vinyl sealer, 1 coat colour pigmented interior wood stain and 2 coats medium/low sheen type catalyzed lacquer finish to the approval of the Engineer. Pressure treated.
- C. Frames - (with plastic laminate doors).
  - 1. Solid hardwood, pressure treated, paint finish. Colour to match plastic laminate.
- D. Plastic Laminate.
  - 1. To meet specified requirements of BS 3794 Part 1, or BS 4965 as applicable for use, of NEMA LD3, GP-50 (1.27mm nominal thickness), of texture and colour (1.27mm nominal thickness), and of texture and colour as per product schedule.
  - 2. Acceptable Manufacturers;
    - a. Wilsonart, or
    - b. Neverman, or
    - c. Formica
    - d. or approved equivalent

#### 1.4. DOOR CONSTRUCTION

- A. General
  - 1. Fabricate doors and transom panels to designs as indicated on Drawings and Door Schedules.



2. Fabricate doors 45mm thick. Side edges and rails 35mm minimum thickness at exposed edges species to be same as facing. Grade mark bottom rail of doors.
  3. Incorporate solid wood blocking at locations where hinges, locksets, closures and similar hardware is installed and applied.
  4. Doors undercut by more than 15mm shall be prepared in factory.
- B. Edge Strips.
1. Edge strips of stiles shall be of same species and grade as face veneer.
  2. Match grain and colour of edge strips to face veneer in doors with stained finish.
  3. Seal door edges in shop.
  4. Bevel edges of lock stiles of single-acting doors.
  5. Fabricate astragals for paired single-acting doors.
- C. Plastic Laminate Faced Doors.
1. Fabricate plastic laminate faced doors as for paint finish wood veneered doors. Laminate to be as indicated in the product schedule.
  2. Sand back of plastic laminate to ensure bond.
  3. Apply facing in shop by heat and pressure to ensure smooth distortion-free surfaces. Use sealers and adhesives as specified by plastic laminate manufacturer for applicable materials and usage.
  4. Provide hardwood edges and finish smooth and flush with facing.
  5. Fabricate door to proper dimensions in the factory incorporating undercut.
- D. Glass Lights.
1. Prepare doors to receive glass as indicated on Drawings and Schedules.
  2. Fabricate framing and stops as detailed.
  3. Glass is specified for installation under the Work of Section 088000.
- E. Panels.
1. Fabricate panels for transoms of same core, edge and facing materials as for doors.
  2. Rebate top of doors and bottom of transom panels.
- F. Door Bumpers.
1. Install single stud rubber at all frames, three bumpers in single door frames, two per leaf at double door frames.
- 3.6.3.3 PART 3 - EXECUTION
- 1.1. EXAMINATION
- A. Verify existing conditions before starting work.
  - B. Verify that opening sizes and tolerances are acceptable.
  - C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.
- 1.2. INSTALLATION
- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
    1. Install fire-rated doors in accordance with NFPA 80 requirements.



2. Use machine tools to cut or drill for hardware.
  3. Coordinate installation of doors with installation of frames and hardware.
  4. Coordinate installation of glazing.
- 1.3. **TOLERANCES**
- A. Maintain tolerances for doors specified in BS 4787 Part 1, as tested in accordance with BS 5277 EN 24 for flatness and BS 951 for squareness.
- 3.1. **ADJUSTING**
- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.
- 3.2. **SCHEDULE**
- A. Refer to Door Schedule on Drawings

**END OF SECTION 08 14 16**

**3.6.4 SECTION 08 31 13 – ACCESS DOORS AND FRAMES**

**3.6.4.1 PART 1 - GENERAL**

**1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2. SUMMARY**

A. Section Includes:

1. Access doors and frames for walls and ceilings.
2. Floor access doors and frames.

B. Related Requirements:

1. MEP Specifications

**1.3. ACTION SUBMITTALS**

A. Product Data: For each type of product.

1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings:

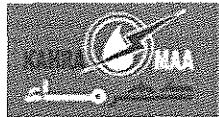
1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Samples: For each door face material, at least 75 by 125 mm in size, in specified finish.

D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

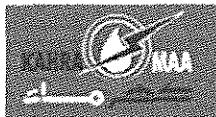
**3.6.4.2 PART 2 - PRODUCTS**

**1.1. PERFORMANCE REQUIREMENTS**



- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labelled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
  2. NFPA 288 for fire-rated access door assemblies installed horizontally.
- 1.2. ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS
  - A. Manufacturer
    - a. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
    - b. Substitutions: See Section 016000 - Product Requirements.
  - B. Flush Access Doors with Exposed Flanges:
  - C. Basis-of-Design Product: Picture frame type
  - D. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
    1. Locations: Wall and ceiling if required.
    2. Door Size: as per drawings and MEP requirements.
    3. Metallic-Coated Steel Sheet for Door: 1.2mm.
      - a. Finish: Factory finish. Colour white RAL 9010 20% gloss, unless otherwise specified.
    4. Frame Material: Same material, thickness, and finish as door.
    5. Hinges: Manufacturer's standard.
    6. Hardware: Budget Lock.
  - E. Flush Access Doors with Concealed Flanges:
    1. Basis-of-Design Product: Frameless, flush type.
    2. Assembly Description: Fabricate door to fit flush to frame. Provide frame with plaster beads for concealed flange installation.
    3. Locations: Masonry walls to MEP risers as indicated on drawings.
    4. Door Size: as per drawings and MEP requirements.
    5. Metallic-Coated Steel Sheet for Door: 1.2mm.
    6. Finish: Factory finish. Colour white RAL 9010 20% gloss, unless otherwise specified.
    7. Frame Material: Same material and thickness as door.
    8. Hinges: Manufacturer's standard

Hardware: Budget Lock.
  - F. Fire-Rated, Flush Access Doors with Exposed Flanges:
    1. Basis-of-Design Product: Indicated on Drawings.
    2. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.



3. Locations: Masonry walls to MEP risers as indicated on drawings.
  4. Door Size: as per drawings and MEP requirements.
  5. Fire-Resistance Rating: Not less than 90 minutes.
  6. Metallic-Coated Steel Sheet for Door: 1.2mm.
    - a. Finish: Factory finish. Colour white RAL 9010 20% gloss, unless otherwise specified.
  7. Frame Material: Same material and thickness as door.
  8. Hinges: Manufacturer's standard.
  9. Hardware: Budget Lock.
- G. Fire-Rated, Flush Access Doors with Concealed Flanges:
1. Basis-of-Design Product: Indicated on Drawings.
  2. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.
  3. Locations: Masonry walls to MEP risers as indicated on drawings.
  4. Door Size: as per drawings and MEP requirements.
  5. Fire-Resistance Rating: Not less than 90 minutes.
  6. Metallic-Coated Steel Sheet for Door: 1.2mm.
    - a. Finish: Factory finish. Colour white RAL 9010 20% gloss, unless otherwise specified.
  7. Frame Material: Same material and thickness as door.
  8. Hinges: Manufacturer's standard.
  9. Hardware: Budget Lock.
- H. Lightweight Flush Access Ceiling Hatch:
1. Basis-of-Design Product: ceiling hatch for plasterboard
  2. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width frame for surface mounting, proportional to door size.
  3. Locations: Ceiling.
  4. Door Size: as per drawings and MEP requirements.
  5. Metallic-Coated Steel Sheet for Door: 1.2mm.
    - a. Finish: Factory finish. Colour white RAL 9010 20% gloss, unless otherwise specified.
  6. Frame Material: Same material and thickness as door.
  7. Hinges: Manufacturer's standard.
  8. Hardware: Budget Lock.
- I. Hardware
1. Latch: Cam latch operated by hex-head wrench or pinned-hex-head wrench with interior release.
  2. Lock: Mortise cylinder with interior release.
- 1.3. MATERIALS
- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.



- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) metallic coating.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793, manufacturer's standard finish.
- F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines or blend into finish.
- G. Frame Anchors: Same type as door face.
- H. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

#### **1.4. FABRICATION**

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
  - 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
  - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
  - 3. Provide mounting holes in frame for attachment of masonry anchors.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
  - 1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
  - 1. For cylinder locks, furnish two keys per lock and key all locks alike.
  - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

#### **1.5. FINISHES**

- A. Comply with NAAMM's "Metal Finishes Manual for Engineering and Metal Products" for recommendations for applying and designating finishes.



- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
  - 1. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 0.025 mm for topcoat. Finish colour to be white unless otherwise stated.

#### **3.6.4.3 PART 3 - EXECUTIONS**

##### **1.1. EXAMINATION**

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

##### **1.2. INSTALLATION**

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

##### **1.3. ADJUSTING**

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

#### **3.6.5 SECTION 08 33 23 – OVERHEAD COILING DOORS / ROLLER SHUTTERS**

##### **3.6.5.1 PART 1 - GENERAL**

###### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

###### **1.2. SUMMARY**

###### **A. Section Includes:**

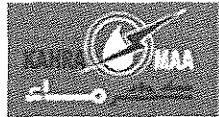
- 1. Loading bay shutter doors.
- 2. Parking Entrance shutter doors.
- 3. Mechanical shutter doors.

###### **B. Related Sections:**

- 1. Section 099000 "Paints & Coatings"
- 2. MEP Sections for electrical service and connections for powered operators and accessories.

###### **C. Related Schedules:**

- 1. Door Schedule



**1.3. PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.
  - A. Wind Loads: Uniform pressure (velocity pressure) nominated by structural engineer, acting inward and outward.
    - a. Maximum Basic Wind Speed: 45m/s.
  - B. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
- C. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of maximum basic wind speed, wind load, acting inward and outward.
- D. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined based upon the local designation of seismic zone designation of 2A.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified".
- E. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

**1.4. SUBMITTALS**

- A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
  - 1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
  - 3. for fire-rated doors, description of fire-release system including testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of site assembly, components, and location and size of each site connection.
  - 2. Show locations of replaceable fusible links.
  - 3. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colours and textures available for units with factory-applied finishes.
  - 1. Include similar Samples of accessories involving colour selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Curtain Slats: 300mm long.
  - 2. Bottom Bar: 150mm long with sensor edge.



3. Guides: 150mm long.
  4. Brackets: 150mm square.
  5. Hood: 150mm square.
- E. Delegated-Design Submittal: For overhead coiling doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of seismic restraints.
  2. Summary of forces and loads on walls and jambs.
- F. Qualification Data: For qualified Installer.
- G. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.
- H. Maintenance Data: For overhead coiling doors to include in maintenance manuals.
- 1.5. QUALITY ASSURANCE**
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
1. Obtain operators and controls from overhead coiling door manufacturer.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labelled fire-rated door assemblies except for size.
  2. Smoke Control: Where indicated in corridors and smoke barriers, provide doors that are listed and labelled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UBC Standard 7-2; with maximum air-leakage rate of 0.01524 cu. m/s x m<sup>2</sup> of door opening at 24.9 Pa for both ambient and elevated temperature tests.
- D. Sound-Control Doors: Assemblies that have been fabricated and tested to control the passage of sound and have minimum certified STC rating according to ASTME 413.
- E. Electrical Components, Devices, and Accessories: Listed and labelled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

#### **3.6.5.2 PART 2 - PRODUCTS**

##### **1.1. DOOR CURTAIN MATERIALS & CONSTRUCTION**

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise

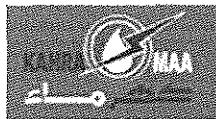


indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with Z275 zinc coating; nominal sheet thickness (coated) of 0.7mm and as required to meet requirements.
  2. Aluminium Door Curtain Slats: ASTM B 209M sheet or ASTM B 221M extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 1.27 mm and as required to meet requirements.
  3. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection rated glass as required for type of door; set in glazing channel secured to curtain slats.
  4. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
  5. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
  6. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.
- B. Endlocks and Windlocks for external Roller Shutters: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
  - C. Endlocks for Counter Shutters: Manufacturer's standard locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
  - D. Bottom Bar for Roller Door Shutters: Consisting of two angles, each not less than 38 by 38 by 3 mm thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminium extrusions to match curtain slats and finish.
  - E. Bottom Bar for Counter Doors: Manufacturer's standard continuous channel or tubular shape, fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminium extrusions to match curtain slats and finish.
  - F. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
  - G. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

#### 1.2. HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb



mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.70 mm thick, hot-dip galvanized steel sheet with Z275 zinc coating, complying with ASTM A 653/A 653M.
2. Aluminium: 1.0 mm thick aluminium sheet complying with ASTM B 209M, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
3. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

#### **1.3. COUNTER SHUTTER DOORS**

- A. Integral Frame, Hood, and Fascia for Counter Shutter: Welded sheet metal assembly of the following sheet metal:
  1. Galvanized Steel: Nominal 0.70 mm thick, hot-dip galvanized steel sheet with Z275 zinc coating, complying with ASTM A 653/A 653M.
- B. Integral Metal Sill for Counter Shutter: Fabricate sills as integral part of frame assembly of Type 304 stainless steel in manufacturer's standard thickness with No. 4 finish.

#### **1.4. LOCKING DEVICES**

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly for Counter shutter: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  1. Lock Cylinders: Provide cylinders standard with manufacturer and keyed to building keying system.
  2. Keys: Provide 3 for each cylinder.
- C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

#### **1.5. CURTAIN ACCESSORIES**

- A. Smoke Seals: Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.
  1. At door head, use 3 mm thick, replaceable, continuous sheet secured to inside of hood.
  2. At door jambs, use replaceable, adjustable, continuous, flexible, 3 mm thick seals of flexible vinyl, rubber, or neoprene.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
  1. Provide pull-down straps or pole hooks for doors more than 2000 mm high.



- D. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic- closing device that is inoperative during normal door operations and that has a governor unit complying with NFPA 80 and an easily tested and reset release mechanism designed to be activated by the following:
1. Building fire-detection and -alarm systems and manufacturer's standard UL-labeled door- holder-release devices.

#### **1.6. COUNTERBALANCING MECHANISM**

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self- lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural- quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 2.5 mm/m of span under full load.
- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

#### **1.7. MANUAL SHUTTER DOOR OPERATORS**

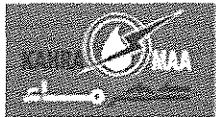
- A. Equip counter shutter with manufacturer's recommended manual door operator unless another type of door operator is indicated.
- B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 110N.
- C. Manual back-up Chain-Hoist Operator for motor operated shutters: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 130N force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide. Chain may be concealed during normal operation and only accessible when manual override is required.

#### **1.8. ELECTRICAL SHUTTER DOOR OPERATORS**

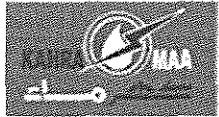
- A. General: Electric shutter operator assembly of size and capacity recommended and provided by shutter manufacturer for shutter[specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking shutter, and accessories required for proper operation.
  1. Comply with NFPA 70.
  2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.



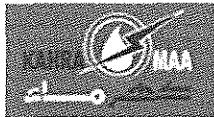
- B. Usage Classification: Electric operator and components capable of operating for not less than 60 cycles per hour for each shutter.
- C. Shutter Operator Location(s): Operator location to manufacturer's recommendations and where possible, as indicated on drawings.
- D. Electric Motors: Comply with BS EN 12604:2000 and BS EN 12453:2001 and/ or NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements for Equipment" unless otherwise indicated.
  - 1. Electrical Characteristics:
    - a. Phase: Polyphase.
    - b. Volts: 415 V.
    - c. Hertz: 50.
  - 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
  - 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate shutter in either direction from any position, at a speed not less than 0.2m/s and not more than 0.3m/s without exceeding nameplate ratings or service factor.
  - 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
  - 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized shutter with adjustable switches interlocked with motor controls and set to automatically stop shutter at fully opened and fully closed positions.
- F. Obstruction Detection Device: Equip motorized shutter with indicated external automatic safety sensor capable of protecting full width of shutter opening. For non-fire-rated shutters, activation of device immediately stops and reverses downward shutter travel. For fire-rated shutters, activation delays closing.
  - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in shutter opening without contact between shutter and obstruction.
    - a. Self-Monitoring Type: Designed to interface with shutter operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, shutter closes only with sustained pressure on close button.
  - 2. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Self-Monitoring Type: Four-wire configured device designed to interface with shutter operator control circuit to detect damage to or disconnection of sensor edge.
- G. Remote-Control Station: Momentary-contact open, sustained-contact close, three-button control station with push-button controls labelled "Open," "Close," and "Stop."



1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
  2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- H. Emergency Manual Operation: Equip each electrically powered shutter with capability for emergency manual operation. Design manual mechanism so required force for shutter operation does not exceed 130N
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm to sound during operation of motorized shutters.
- 1.9. LOADING BAY SHUTTERS / COUNTER DOOR ASSEMBLIES.
- A. Loading Bay Roller Shutters: Overhead coiling shutters formed with curtain of interlocking insulated metal slats.
1. Manufacturers: Hormann or Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  2. Substitutions: See Section 016000 - Product Requirements.
- B. Operation Cycles: Not less than 100,000
1. Include tamperproof cycle counter.
- C. STC Rating: 26.
- D. Exterior Exposed Curtain Composition U-Value: 0.35 W/m<sup>2</sup>k
- E. Door Curtain Material: Insulated Steel.
- F. Shutter Curtain Slats: Insulated Curved or Flat profile slats of approximately 120mm as per manufacturer's standard.
- G. Insulated-Slat Interior Facing: Metal.
- H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- I. Hood: Galvanized steel.
1. Shape: Square as per manufacturer's standard.
  2. Mounting: Face of wall.
- J. Integral Frame, Hood, and Fascia for Counter Door: Galvanized steel.
- K. Sill Configuration for Counter Door: Integral metal sill.



- L. Locking Devices: Equip shutter with slide bolts for padlocks or locking device assembly and chain lock keeper.
    - 1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside and outside with cylinders.
  - M. Electric Shutter Operator:
    - 1. Usage Classification: Heavy duty, 60 to 90 cycles per hour.
    - 2. Operator Location: Manufacturer's standard. To be approved by Engineer.
    - 3. Motor Exposure: Exterior, wet, and humid.
    - 4. Emergency Manual Operation: Chain type.
    - 5. Obstruction-Detection Device: Automatic photoelectric sensor or electric sensor edge on bottom bar or pneumatic sensor edge on bottom bar; self-monitoring type.
      - a. Sensor Edge Bulb Colour: Black.
    - 6. Remote-Control Station: Interior.
    - 7. Other Equipment: Audible and visual signals.
  - N. Door Shutter Finish:
    - 1. Baked-Enamel or Powder-Coated Finish: Colour as selected by Engineer from manufacturer's full range.
    - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.
- 1.10. FIRE-RATED DOOR SHUTTER ASSEMBLY
- A. Fire-Rated Counter Shutter: Overhead fire-rated coiling shutter formed with curtain of interlocking metal slats.
  - B. Manufacturers: Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer. Substitutions: See Section 016000 - Product Requirements.
  - C. Fire Rating: 90 minutes with smoke control.
  - D. Door Curtain Material: Galvanized steel
  - E. Door Curtain Slats: Manufacturer's standard.
  - F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
  - G. Integral Frame, Hood, and Fascia for Counter Door: Galvanized steel.
    - 1. Mounting: Face of wall within uniform store.
  - H. Sill Configuration for Fire-Rated Counter Door: Integral metal sill.
    - 1. Locking Devices: Equip door with locking device assembly.
  - I. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside uniform store.
  - J. Manual Door Operator: Push-up operation or manufacturer's recommendation.
  - K. Door Finish:
    - 1. Baked-Enamel or Powder-Coated Finish: Colour as selected by Engineer from manufacturer's full range.



#### 1.11. GENERAL FINISHES REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

#### 1.12. STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

#### 3.6.5.3 PART 3 - EXECUTION

##### 1.1. EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

##### 1.2. INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

##### 1.3. STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform start-up service.
  1. Perform installation and start-up checks according to manufacturer's written instructions.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

##### 1.4. ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.



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- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide weathertight fit around entire perimeter of external roller shutters.

**1.5. DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

**END OF SECTION 08 33 23**



### **3.6.6 SECTION 08 51 13 – ALUMINIUM WINDOWS**

#### **3.6.6.1 PART 1 – GENERAL**

##### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2. SUMMARY**

- A. Section includes aluminium windows for exterior locations.

##### **B. Related Requirements:**

1. Section 084113 "Aluminium-Framed Entrances and Storefronts" for coordinating finish among aluminium fenestration units.

##### **1.3. PREINSTALLATION MEETINGS**

- A. Pre-installation Conference: Conduct conference at Project site.
- B. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- C. Review and discuss the finishing of aluminium windows that is required to be coordinated with the finishing of other aluminium work for colour and finish matching.
- D. Review, discuss, and coordinate the interrelationship of aluminium windows with other exterior wall components. Include provisions for anchorage, flashing, sealing perimeters, and protecting finishes.
- E. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
- F. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

##### **1.4. SUBMITTALS**

###### **A. Product Data: For each type of product.**

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminium windows.

###### **B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.**

###### **C. Samples: For each exposed product and for each colour specified, 50 by 100 mm in size.**

###### **D. Samples for Initial Selection: For units with factory-applied colour finishes.**

1. Include similar Samples of hardware and accessories involving colour selection.

###### **E. Samples for Verification: For aluminium windows and components required, showing full range of colour variations for finishes, and prepared on Samples of size indicated below:**

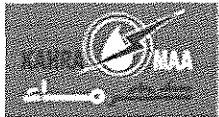
1. Exposed Finishes: 50 by 100 mm.

2. Exposed Hardware: Full-size units.

###### **F. Product Schedule: For aluminium windows. Use same designations indicated on Drawings.**

##### **1.5. INFORMATIONAL SUBMITTALS**

###### **A. Qualification Data: For manufacturer and Installer.**



- B. Product Test Reports: For each type of aluminium window, for tests performed by a qualified testing agency.

- C. Field quality-control reports.

- D. Sample Warranties: For manufacturer's warranties.

#### **1.6. QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminium windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

- B. Installer Qualifications: An installer acceptable to aluminium window manufacturer for installation of units required for this Project.

- C. Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

- D. Build mock-up of typical wall area as shown on Drawings.

- E. Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Architect specifically approves such deviations in writing.

#### **1.7. WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminium windows that fail in materials or workmanship within specified warranty period.

- B. Failures include, but are not limited to, the following:

- 1. Failure to meet performance requirements.

- 2. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.

- 3. Faulty operation of movable sash and hardware.

- 4. Deterioration of materials and finishes beyond normal weathering.

- 5. Failure of insulating glass. Verify available warranties and warranty periods for units and components. Some manufacturers might insist that warranty periods begin on date of manufacture or sale.

- C. Warranty Period:

- 1. Window: 10 years from date of Substantial Completion.

- 2. Glazing Units: 5 years from date of Substantial Completion.

- 3. Aluminium Finish: 10 years from date of Substantial Completion.

#### **3.6.6.2 PART 2 – PRODUCTS**

##### **1.1. MANUFACTURERS**

- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.

- C. Source Limitations: Obtain aluminium windows from single source from single manufacturer.

##### **1.2. WINDOW PERFORMANCE REQUIREMENTS**



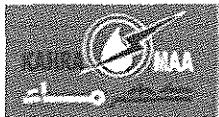
- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.  
Window Certification: AMMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:  
Minimum Performance Class: As indicated on Drawings. AAMA/WDMA/CSA 101/I.S.2/A440 establishes a gateway Performance Grade for windows to qualify for each Performance Class. The gateway Performance Grade is 15 for Class R, 25 for Class LC, 30 for Class CW, and 40 for Class AW. For a particular project, the minimum Performance Grade for windows is typically based on the design pressure.  
Minimum Performance Grade: As indicated on Drawings.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor according to Kahramaa's requirements.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30.CRFs are typically between 45 and 75.
- E. Condensation-Resistance Factor (CRF): Provide aluminium windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- F. Thermal Movements: Provide aluminium windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. G. Base engineering calculation on surface temperatures of materials due to both solar heat gain and night time-sky heat loss.
- G. Sound Transmission Class (STC): Rated for not less than 30 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- H. Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.

### 1.3. ALUMINIUM WINDOWS

- A. Operating Types: Provide the following operating types in locations indicated on Drawings:
  1. Single hung.
  2. Double hung.
  3. Horizontal sliding.
  4. Fixed.
- B. Frames and Sashes: Aluminium extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
- C. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal.
- D. Insulating-Glass Units: ASTM E 2190, certified through IGCC as complying with requirements of IGCC.
  1. Glass: ASTM C 1036, Type 1, Class 1, q3.



- a. Tint: Grey.
- b. Kind: Fully tempered where indicated on Drawings.
- 2. Lites: Two.
- 3. Filling: Fill space between glass lites with argon.
- 4. Low-E Coating: Pyrolytic on second surface.
- E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
  - 1. Dual Glazing:
    - a. Interior Lite: Glass
    - b. Exterior Lite: Insulating-glass unit.
- F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminium, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
  - 1. Exposed Hardware Colour and Finish: As selected by Engineer from manufacturer's full range.
- G. Projected Window Hardware:
  - 1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
    - a. Type and Style: As selected by Engineer from manufacturer's full range of types and styles.
  - 2. Hinges: Non-friction type, not less than two per sash.
  - 3. Lock: Key-operated custodial lock with keeper and removable handle.
  - 4. Pole Operators: Tubular-shaped anodized aluminium; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 1500 mm above floor; one pole operator and pole hanger per room that has operable windows more than 1800 mm above floor.
- H. Hung Window Hardware:
  - 1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
  - 2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only. Provide custodial locks.
  - 3. Tilt Latch: Releasing latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior.
- I. Horizontal-Sliding Window Hardware:
  - 1. Sill Cap/Track: Extruded-aluminium track with natural anodized finish, Manufacturer's standard of dimensions and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
  - 2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only. Provide custodial locks.
  - 3. Roller Assemblies: Low-friction design.



- J. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
- L. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

#### **1.5. ACCESSORIES**

- A. Integral Ventilating System/Device: Where indicated, provide weather-stripped, adjustable, horizontal fresh-air vent, with a free airflow slot, full width of window sash by approximately 75 mm when open, complying with AAMA/WDMA/CSA 101/I.S.2/A440. Equip vent bar with an integral insect screen, removable for cleaning.
- B. Dividers (False Muntins): Provide extruded-aluminium divider grilles in designs indicated for each sash lite.
- C. Sub-sills: Nonthermal, extruded-aluminium sub-sills in configurations indicated on Drawings.
- D. Column Covers: Extruded-aluminium profiles in sizes and configurations indicated on Drawings.
- E. Interior Trim: Extruded-aluminium profiles in sizes and configurations indicated on Drawings.
- F. Panning Trim: Extruded-aluminium profiles in sizes and configurations indicated on Drawings.
- G. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminium receptor system that anchors windows in place.

#### **1.6. INSECT SCREENS**

- A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
  - 1. Type and Location: Half, outside for sliding sashes.
- B. Aluminium Frames: Manufacturer's standard aluminium alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
  - 1. Tubular Framing Sections and Cross Braces: Roll formed from aluminium sheet.
- C. Aluminium Wire Fabric: 1.1-by-1.3-mm mesh of 0.28-mm diameter, coated aluminium wire.
  - 1. Wire-Fabric Finish: Charcoal grey.

#### **1.7. FABRICATION**

- A. Fabricate aluminium windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminium windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.



- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

#### 1.8. GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

#### 1.9. FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminium Association for designating aluminium finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- D. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic E. Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
  - 4. Organic Coating: Thermosetting, modified-acrylic or polyester enamel primer/topcoat system complying with AAMA 2603, except with a minimum dry film thickness of 0.04 mm, medium gloss.
  - 5. Colour: As selected by Engineer from full range of industry colours and colour densities.
- E. High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 50% polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 AAMA 2605 and with coating and resin manufacturers' written instructions.
  - 1. Colour and Gloss: As selected by Engineer from full range of industry colours and colour densities.



- F. High-Performance Organic Finish (Three-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; H. Organic Coating: manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Colour and Gloss: As selected by Engineer from full range of industry colours and colour densities.

### 3.6.6.3 PART 3 – EXECUTION

#### 1.1. EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapour retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 1.2. INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminium and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

#### 1.3. FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- C. Testing Services: Testing and inspecting of installed windows shall take place as follows:
  1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
  2. Air-Infiltration Testing:



- a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
  - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
  - 3. Water-Resistance Testing:
    - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    - b. Allowable Water Infiltration: No water penetration.
  - 3. Testing Extent: Three mock-up windows of each type as selected by Engineer and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
  - 4. Test Reports: Prepared according to AAMA 502.
  - D. Remove and replace noncomplying windows and retest as specified above.
  - E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  - F. Prepare test and inspection reports.
- 1.4. ADJUSTING, CLEANING, AND PROTECTION**
- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
  - B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
    - 1. Keep protective films and coverings in place until final cleaning.
  - C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
  - D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

### **3.6.7 SECTION 08 71 00 – DOOR HARDWARE**

#### **3.6.7.1 PART 1 - GENERAL**

##### **1.1. SCOPE**

- A. It is the intent that this section shall provide for the supply of all items of finishing hardware and adequately service to this project.

##### **1.2. SECTION INCLUDES**

- A. Preparation of Hardware and Hardware Set schedule to Engineer approval and Supply of Finishing hardware as scheduled, reviewing in conjunction to Drawings and Specifications.

##### **1.3. GENERAL REQUIREMENTS**



- A. All Hardware should be from one manufacturer and a combination of sources is not acceptable. Supplier should confirm in writing that proposed hardware is from a reputable branded manufacturer and supplier and must identify the source of production by presenting a documented letter from the manufacturer.
- B. Hardware schedule provide convenience of use and maintenance of the building security against unauthorized access (and in some cases exit), escape from, protection against and prevention of fire, smoke spread of toxic atmospheres of other hazards and protection to doors and other surfaces. The Contractor shall ensure that hardware supplied meets with the Engineer's requirements, and if any item proposed or specified detracts there from the Engineer shall be informed. Unless stated, hardware to aluminium units shall be by the aluminium fabricator in accordance with this specification but with finishes to match his sections. Floor spring units, and cover plates, master keyed cylinders and access control hardware shall be by general hardware supplier.
- C. Door hardware and furniture shall be approved types, suitable for the location and the intended function of the doors, in accordance with the Product Information and relevant Standards.
- D. Submit Product Information, and Control Samples.
- E. Verify correct handing, internal external application, compliance to fire rating requirements, if applicable, and suitability of Hardware with the door type and door/frame construction, floor levels, door swing limits for all Hardware items before commencing.
- F. Include fixings, striker plates, shims, and escutcheons for a complete installation, whether indicated or not.
- G. Unless otherwise indicated, door hardware shall enable escape from the inside of the room or area contained by the door hardware.
- H. Door furniture shall be suitable for use with the lock or latch to which it is installed. Include key- ways, key-hole plates, turn-buttons, cut-outs, roses, plates and escutcheons required by the lock or latch type, for a complete installation, whether indicated or not.
- I. Unless the door furniture is indicated separately for each side of the door, supply furniture as a paired set for both side of the door. Furniture fixings on the outside face of doors shall be concealed by fixing through the door from inside or by other appropriate methods.
- J. Unless otherwise indicated, door hardware shall be manufactured from cast, forged or machined brass. Satin Stainless Steel Finish. Other Grade Stainless Steel material is not acceptable. Zinc alloy base material with a stainless steel plating surface or a brass base material with satin chrome plating is not acceptable.
- K. Regardless of other provisions, materials shall meet fire safety requirements and not be subject to bimetallic corrosion. Each item's design and finish shall reflect the nature and quality of the project. Every finished surface of one material, whether extruded, rolled, cast or stamped, shall match exactly in colour and texture all other items.

#### **1.4. RELATED REQUIREMENTS**

##### **A. Related Requirements:**

- 1. Section 062023 - Finish Carpentry.
- 2. Section 081113 – Hollow Metal Doors and Frames.



3. Section 081216 - Aluminium Doors and Frames
4. Section 081416 - Flush Wood Doors.

#### **1.5. REFERENCE STANDARDS**

A. Standards of the following as referenced:

1. European norms E.N set the minimum requirements. Unless more stringent standards are specified, all hardware shall comply with the following European Standards.
  2. BS 476 - Fire tests on building materials and structures
    - a. Part 8 - Test methods and criteria for the fire resistance of elements of building construction.
  3. ANSI/ICCA117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council.
  4. ASTM E 152 - Standard Methods of Fire Tests of Door Assemblies.
  5. BHIF (Builders Hardware Industry Federation) code of practice for hardware for timber fire and escape doors.
  6. BS8424 Pull Handles
  7. BSEN12209 Mortice Locks & Bathroom Locks
  8. EN 1125 Panic exit devices operated by a horizontal bar
  9. EN 1154 Controlled door closing devices
  10. EN 1155 Elec. Powered hold open devices for swing doors
  11. EN 1158 Door coordinator devices
  12. EN 1303 Cylinders for locks, Grade 3
  13. EN 1527 Hardware for sliding doors and folding doors
  14. EN 1634 Fire Testing of door and shutter assemblies.
  15. EN 1670 Corrosion resistance
  16. EN 1906 Lever handles and knob furniture
  17. EN 1935 Hinges, Grade 13
  18. EN 12209 Mechanically operated locks, latches and locking plates.
  19. EN 12365 Gaskets and weather stripping
  20. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
  21. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.

#### **1.6. ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.
- B. All fire and life safety codes shall be met as required by the authority having jurisdiction. For fire rated doors, supply CERTIFI FIRE Certificates and CE Certificates approved door hardware for the following hardware items; Mortice locks, mortice latches, hinges and door closers.

#### **1.7. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Schedule.



1. Prepare and supply 6 copies of a completely detailed hardware schedule. The schedule will list all doors by number including size, hand and degree of opening.
  2. Indicate hands of each door and degree of swing. In the case of pairs of doors indicate the active door. Submit drawing indicating material finish, dimensions, details of construction, fastenings and anchorage for each hardware item, including details for concealed/exposed closers, panic hardware, maglocks, flush bolts, astragals coordinators etc.
  3. The schedule shall incorporate the manufacturer's name and catalogue numbers.
- C. Samples.
1. Submit samples of each hardware type including cabinet pulls/hinges in specified finish and appropriate fasteners.
  2. Complete hardware sample board showing major components proposed.
- D. Provide with templates and hardware schedule, original catalogue cuts of all products proposed. 3 marked original copies of the product catalogue. Items proposed must be in the original product catalogue. Catalogue photocopies are not acceptable.
- E. Prepare for review a key schedule to be coordinated with the Engineer and Kahramaa.
- F. Approved samples may be incorporated in the works unless otherwise directed by the Engineer.
- G. Affidavits.
1. Submit affidavit to verify that hardware has in each case been installed in the correct location and that it is operating correctly.
- H. Certificates:
1. Submit valid product testing performance certificates verifying individual products are successfully tested as follows:
    - a. Hinges certified to EN1935 grade 13.
    - b. Mortice locks and & bathroom locks to BSEN12209.
    - c. Cylinders to EN1303 grade 3.
    - d. Lever handles and knobs to EN1906.
    - e. Pull handles to BS8424.
- I. Fire Rating Certification.
1. Submit valid fire testing certificates verifying products successfully certified to: EN1634-1 fire rating and CERTIFIRE approved.
  2. Where fire rating label requires fire certification longer than 60 minutes, submit separate fire certificate indicating 120 minute fire certification for the following items: mortice locks, cylinders and hinges in addition to CERTIFIRE approved certification.
  3. The supplier must confirm in writing what custom design software program is available within his organization to assist in rapidly implementing changes to the hardware schedules as needed during the course of the project. Word, excel or similar commercial software programs are not acceptable.
  4. The supplier shall offer full technical support and have qualified staff able to prepare or amend hardware schedules and advise on technical issues, while coordinating with the contractor & architect on all matters including master key systems, technical problems of specification, installation and operation.



5. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
  - J. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
  - K. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
  - L. Keys: Deliver with identifying tags to Kahramaa by security shipment direct from hardware supplier.
  - M. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Kahramaa's name and registered with manufacturer.
- 1.8. QUALITY ASSURANCE**
- A. The supplier of finishing hardware shall be regularly involved in the sale and distribution of Builders Hardware for commercial Projects of this nature.
  - B. Hardware furnished for this project shall be as listed, or supplied with approved equivalents as noted.
  - C. The supplier shall employ a qualified Architectural Hardware Consultant (A.H.C.), Dip GAI (Guild of Architectural Ironmongers) or any other approved equivalent qualification to supervise all the issues related to doors and doors hardware. The Hardware consultant will be responsible for architectural submittals, samples submission, to review Hardware sets in conjunction with Drawings, specifications, statutory rules, international standards such as Life Safety code and Disability Act. The Hardware consultant should also look after material deliveries to site, making sure right material is delivered, marked and packed.
- 1.9. DELIVERY, STORAGE, AND HANDLING**
- A. The supply shall ensure that deliver of proprietary packaged products in the manufacturer's original packages and containers with labels intact and legible, including installation instructions, templates and detailed delivery dockets. Packaging of hardware shall be (in):
    1. Complete individual sets for each door.
    2. Separate dust and moisture proof packages.
    3. Clearly labelled to show intended locations.
    4. Complete with required fixings.
  - B. The Contractor shall provide approved weatherproof storage facilities for all hardware delivered to the Worksite.
  - C. Hardware shall be supplied complete with all mounting fixings.
- 1.10. COORDINATION**
- A. Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware.
  - B. Furnish templates for door and frame preparation.
  - C. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
  - D. Coordinate Kahramaa's keying requirements during the course of the Work.
- 1.11. WARRANTY**
- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.



- B. All hardware shall be guaranteed for a period of one year from the date of issue of completion certificate. Lever handles to be guaranteed for a period of five years from the date of issue of completion certificate. Material shall be covered against manufacturing defects or breakage, will- full damage excluded.
- C. The warranty shall include particular reference to failure of, or due to, the following:
  - 1. Correct selection for required location performance
  - 2. Correct functioning of moving parts.
  - 3. Structural adequacy.
  - 4. Chipping, fading, excessive wear or delamination or other deterioration of finishes.
  - 5. Fixing and connectors including stripped threads and damaged heads.
  - 6. Integrity of seals.
  - 7. Sagging, slackness or looseness of knobs and handles due to wear, relaxation of springs, stripped threads, or any other cause.
- D. The warranty shall include an undertaking that spare parts and replacement items will be available for sale off-the-shelf, or with a lead time not exceeding four weeks from date of order, for a period not less than the warranty period.
- E. Warranty shall be accompanied by a current retail price list properly identified and dated.
- F. The warranty shall include an undertaking with respect to price control for the following items:
  - 1. Replacement keys.
  - 2. Replacement cylinders.

#### **1.12. MAINTENANCE INSTRUCTIONS**

- A. Provide maintenance date, parts list and manufacturer's instructions for installation and maintenance for each type of hardware including door closer, lockset, door holders and fire exit hardware for incorporation into maintenance manual.
- B. Provide special wrenches and tools applicable to each different or special hardware component.
- C. Provide 5 No. copies of catalogues for all hardware used for incorporation into maintenance manual. Catalogues cuts shall be original catalogue material.

#### **1.13. EXTRA MATERIALS**

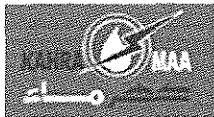
- A. Provide ten extra key lock cylinders for each master keyed group.

#### **3.6.7.2 PART 2 - PRODUCTS**

##### **1.1. MANUFACTURERS**

- A. Refer to Appendix Ironmongery Schedule, Finishes Schedules. Unless otherwise stated in the architectural hardware schedules, all hardware to be supplied is Eurolever Architectural Hardware from The Silver Shore Trading Co. P.O. Box 1881, Dubai U.A.E. Tel. No. +971 4 2628880, Fax No. +971 4 2627775, as per the approved items selected for design intent or alternative approved manufacturers subject to meeting design intent include FSB Germany, D Line Denmark only.
- B. Protection Plates.
- C. Substitutions: See Section 016000 - Product Requirements.

##### **1.2. KEY CONTROL**



- A. Provide an approved proprietary lockable key cabinet with adequate compartments, pockets or hooks to accommodate all required keys
- B. Each key shall be attached to an approved plastic key tag by a metal split ring, properly labelled with the final room name or number.

#### **1.3. FASTENERS**

- A. Furnish all finish hardware with all necessary screws bolts and other fasteners of suitable size and type to anchor hardware in position for long life.
- B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors approved by the Engineer, according to material to which hardware is to be applied and recommendations of hardware manufacturer.
- C. All fastenings shall harmonize with hardware as to material and finish.
- D. Provide suitable, matching, metric, rust proofed fixing devices to suit the location and background, of Allen key, 'SUPADRIV', 'POSIDRIV' or equivalent positive locating drive types. Pull handle fixing shall be bolt through type, unless otherwise specifically required.
- E. Exposed screws for installing hardware shall have Philips or Robertson heads.
- F. Finishes. All hardware shall match

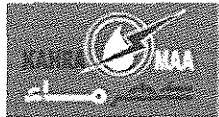
#### **1.4. MATERIALS**

##### **A. Door Seals:**

1. Door seals, including weather seals, smoke seals, acoustic seals and air seals, shall be suitable for the location and the intended function in accordance with the Product Information.
2. Submit product information, and Control Samples if directed.
3. Include fixings, rebates, grooves, and clearances for correct installation and operation of seals.
4. Coordinate with the door-frame manufacturer for required rebates to door-frames.
5. All external door to have suitable weather seals to protect against outside dust, wind and cold.
6. Threshold type to be Saddle/Panic thresholds UL listed ADA compliant. Jamb and header seals proprietary to the aluminium door and frames to be used subject to the approval of the consultant. Jamb and header seals to be with pressure sensitive tape 6.4mm in charcoal finish.

##### **B. Doors Stops:**

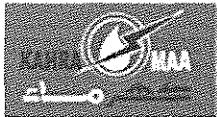
1. Door stops shall be approved proprietary types, suitable for the location and the intended function, in accordance with the Product Information. All doorstops should be robust matching other ironmongery, concealed fixing. Approved doorstops are as per Eurolever model SS1927. Dimensions and other product details as described and indicated in the hardware schedule.
2. Submit product information, and Control Samples if directed.
3. Provide door stops to limit door swing where indicated or required to prevent damage to adjacent work by uncontrolled door opening.
4. Verify floor or wall mounting locations before installation where not indicated. Do not mount door stops to un-reinforced lightweight walls.



5. Where stops for non-fire rated doors are not practicable, provide overhead stays to control door swing.
- C. Door Closers:
  1. Door closers and controllers shall be approved types, suitable for the location and the intended function of the doors, including size and weight of the door, door swings and wind pressure, in accordance with the product information and relevant standards. All door closers to comply with EN 1154 and to be CERTIFIRE labelled and approved.
  2. Where the Fire rated doors are to be used by public, door closer should be Cam-action mechanism, to comply with the maximum opening force needed of 22.5 N at 30-60 degrees as per approved document M 2004 and simultaneously comply to minimum closing force as per BS 8300:2001.
  3. Submit product information, and Controlled Samples if required by the Engineer. Upon submittal of proposed door closer for approval, submit independent fire test certificate indicating closer conforms to EN1634-1, 60 minutes fire resistant.
  4. For heavy or external doors where specified, use Cam-Action door closer as per width and weight parameters of the door. Closing speed and latching speed shall be controlled by separate concealed key operated valves. External doors facing high wind conditions and internal doors likely to be opened with high forces shall be having back check to protect the door and adjacent wall damage. Door closer to be CE marked.
  5. For corridor doors, and doors having public area on both sides, used concealed Cam- Action door closer complete with slide track and arm. Door closer to have two independent values force closing speed adjustment. Door closer to be CE marked.
  6. Door closers to have built in manual hold open feature where required except for fire rated doors. Uses integral electromechanically hold open function with closer where hold open is needed in fire doors. Electromechanical hold open door closers need to close the door automatically in case of fire alarm or power interruption.
  7. Door closer to be adjustable, hydraulic check types, incorporating following features:
    - a. Closing speed fully adjustable between two and thirty seconds (if delayed closing is specified the door, when opened to 90 degrees or beyond, shall stand motionless for a period adjustable up to 60 seconds, before starting to close).
    - b. Opening and closing from any angle up to 180 degrees with check adjustable to operate from any angle between 135 degrees and closed.
    - c. Ten year guarantee in use of local ambient conditions, including positions of extreme exposure and, for back check closers, even if stops are not specified.
    - d. They shall have plain, rectilinear bodies finished identically to other items on the door, suitable rust proof arms, fully concealed fixings and adjustment controls. All closers to meet EN1154a and be fire rated to EN1634-1 60 minute fire rating. Grey colour door closers are not acceptable unless specifically specified in the hardware schedules. Approved door closers are XX100. Dimensions and other product details as described and indicated in the hardware schedule.



8. Double rebated doors to have door closers with integral coordinators GSR for sequential closing of doors.
  9. Floor mounted closers shall be of suitable for single or double action, wood or metal doors by use of compatible fittings, with concealed fixing cover plates.
  10. Door closer to be of EN size 2-4 for doors up to 1100mm wide and 80kg weight.
  11. Door closer to be of EN size 2-6 for doors up to 1400mm wide and 120kg weight.
  12. Door closer to be of EN size 7 for door up to 1600mm wide and 160kg weight.
  13. Where practicable, surface mounted closers shall be concealed from view by mounting inside rooms and stairwells. Do not fix closer to the visible side of public corridors, foyers or the like. In case it is desirable door closer not to be seen from both sides, Concealed type door closer to be used which is installed inside the cut out on frame or door and the closer is not visible from both sides of the door.
- D. Hinges:
1. Hinges shall be suitable to match other items on the doors. Hinges shall be triple knuckle ball bearing type to minimize closing friction and prevent wear.
  2. Aluminium hinges are not acceptable.
  3. All hinges shall be independently tested to EN1935 Grade 13 and fire standard EN1634 -1. Acceptable hinges are Eurolever SS5 or equal and approved.
  4. Hinge size to be 4X3X3mm thickness.
  5. Where indicated on the hardware schedule, supply 4.5mmX4.5mmX3.4mm thick, ANSI dimensioned hinges, ball bearing, fire rated to EN1634-1, minimum fire rating 120 minutes. Approved hinges are SS5, or equal and approved.
  6. Independent test certificates indicating conformity with above mentioned indicated standards must be provided at the time of submittal as evidence that the hinges proposed conform to hardware industry certification, EN1935 Grade 13 and EN1634-1.
  7. All hinges to be CERTIFIRE labelled and approved and CE marked.
- E. Lever Handle Sets:
1. Lever handles shall be approved types, suitable for the location and the intended function of the doors.
  2. Submit product information, and Controlled Samples if required.
  3. Lever Handles shall be as per the design intent described below. All lever handles to be made from Satin stainless steel material. The levers shall be supplied complete with H.T. spindle suitable for door thickness between 35mm and 54mm.
  4. Lever handles shall be as per the described lever handle model in the hardware specification schedule.
  5. The lever handles should be solid body stainless steel unless stated otherwise in the hardware schedules. The lever handles should be on non-sprung unless stated otherwise in the hardware schedules.
  6. In general lever edges and surfaces to be smooth and curved.



7. Approved lever handles is Eurolever Strasbourg Collection Model SS2002, both fitted on 50mm diameter, 4mm thick roses, as described and indicated in the hardware schedule and fitted with concealed ball bearing technology for frictionless movement.
8. All lever handles to be supplied on a 4mm thick, 50mm diameter roses, with polished edges, capable of being rigidly fixed to door.
9. Concealed fixing base for roses should be rigid and allow for bolt thru fixing.
10. Independent test certificate indicating conformity with Industry performance standard EN1906 to be provided at the time of submittal confirming proposed lever handles conform to this specific certification standard.
11. For narrow stile doors narrow profile rose, escutcheons and cranked level handle to be used. For WC doors same trims to be used with WC indicator.

**F. Pull Handles:**

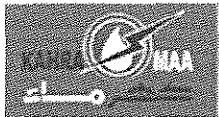
1. Pull handles shall be approved types, suitable for the location and the intended function of the doors.
2. Submit product information, and Controlled Samples if required.
3. Pull handles should be as specified in the hardware schedule for all doors including but not limited to wardrobe doors, kitchen sliding doors and other doors.
4. They shall be supplied with bolt through fixings employing countersunk corrosion proofed bolts cup washers and locking patches. Approved pull handles are SS2300 as dimensions and other product details as described and indicated in the hardware schedule. All pull handles must be tested and comply with BS8424.

**G. Mortise Locks:**

1. Locks and latches shall be approved types, suitable for the location and the intended function in accordance with the relevant standards.
2. Mortise locks and latches shall conform to industry performance requirement BS EN 12209 and industry fire rating standard EN 1634-1, 60 minutes. Submit product information, and Control Samples if directed.
3. All mortice lock and latches to be CERTIFIRE labelled and approved.
4. Unless otherwise indicated, locksets and latch-sets shall be mortise type. Use only proprietary strike plates nominated for the required locks or latches.
5. All latch-sets and locksets shall be from one manufacturer, unless otherwise indicated.
6. Lock case to be sealed, zinc plated. Latch and/or bolt to be nickel-plated. Bolt projection to be double throw, 20mm, with 8mm square steel follower mounted in drawn steel bushes. Springs and other moving parts not fabricated from brass shall be corrosion-resistant steel alloy or stainless steel. The forends to be 24mm width, square edges, of stainless steel material in satin finish. Locks to be for euro profile cylinders with 55mm back set. For narrow stile doors the lock back set to be less than or equal to 35mm. Latch should be steel material for Fire rated doors.
7. High frequency doors should have special bronze-bushed self-adjusting clamp follower for Rattle-free lever handles and maintenance free, lubricated silent pattern latch.



8. Lock suites for use on fire rated door assemblies shall be independently tested and certified as not compromising fire rating and shall not contain plastics, zinc or other low melting point components.
  9. Independent certificates indicating conformity with indicated standards must be provided.
  10. Furthermore the proposed mortice lockcase should conform to:
    - a. Deadbolts incorporating anti-sawing hardened steel rollers, 16mm thick.
    - b. If for lever handles, special springing against progressive lever droop (levers with sprung roses are unacceptable due to potential for damage and corrosion.)
    - c. Facility for full reversal of hand, without opening the case.
    - d. Suitable forends, strike plates and rebate components if for rebated meeting styles, of non-corroding materials to match handles.
    - e. All locks to have backset of 60mm.
    - f. Approved Eurolever locks are: SS1.6, SS2.6, SS3.6 & 4.6.
- H. Key and Cylinders:
1. Cylinders shall be approved types, suitable for the location and the intended function in accordance with the relevant standards.
  2. Cylinder to conform to performance standard EN1303 grade 3 & fire rating EN1634.
  3. Independent test certificate indicating conformity with above mentioned standards must be provided at the time of submittal confirming cylinders proposed conform to hardware industry certification, EN1303 grade 3 and EN1634-1.
  4. Submit product information, and Control Samples if directed.
  5. Cylinders to be Euro-Profile keyed under a master key system, each cylinder to have 3 change keys. The cylinders should have protection against picking, scanning, and manipulation. The cylinder should have a solid steel cam and special key way.
  6. Master keying to be done in factory and records maintained. Access to additional keys to be through authorized representative of owner only. The master key system should have 3 keys per cylinder and master keys based on key schedule approved by the consultant. The system should have a capability of expansion of 50% for the future.
  7. Where specified cylinders to have thumb-turn on one side. Exit devices which have a trim, should have single cylinder.
  8. Cylinders shall be interchangeable between different manufacturers.
  9. Cylinders shall be 6 pin, 61mm in length with practically infinite differs, finished to match handles and trim (includes coloured finishes), easily removable with the door open, without dismantling trim but not removable if closed. Three keys per cylinder required. The cylinder shall have Para centric keyways and TG pins to prevent picking and hardened steel drives pins and body insert to overcome drilling.
  10. Cylinders and keys shall be code stamped with an identification number in an approved location. Verify identification numbers with the Principal before stamping.
  11. 7.4 Include for master keying for all cylinders, details to be provided by architect.
- I. Flush Bolts:



1. Flush bolts shall be approved proprietary types, suitable for the location and the intended function, in accordance with the Product Information.
  2. Submit product information, and Control Samples if directed.
  3. Inactive leaf of double doors except those having exit devices, to have manual bolts. Rebated doors or doors having astragal where closing of the leaves is controlled by door coordinator; the flush bolt should be automatic type that bolts the door automatically when closed. Frame at the top to have flush bolt strike and flooring at the bottom to have Dust Proof strike to receive the bolts.
  4. Door with heights above 2200mm, to have extension bolt for the top manual flush bolt for easy access.
  5. Lever action flush bolts appropriate to the type of the door i.e., Steel/wood/Aluminium should be used.
  6. To be fitted at top and bottom of non-active leaf of door pairs. Flush bolts to be provided having a 19mm throw and a 225mm body with a dovetail return ensuring no damage to the door. Acceptable flush bolts as per Eurolever model SS1932, dimensions and other product details as described and indicated in the hardware schedule. Flush bolt must be tested to EN1634-1 fire rating, supply testing evidence conforming to performance standard EN12051.
  7. Suitable easy clean dirt excluding spring type sockets to be provided as described in the hardware schedule. Acceptable easi-clean socket as per Eurolever model SS1934.
- J. Mop Plates, Kick Plates and Push Plates:
1. Door protection plates shall be approved proprietary types, suitable for the location and the intended function, in accordance with the Product Information.
  2. Submit product information, and Control Samples if directed.
  3. Applied facings to doors and kick plates shall be approved types to match control samples.
  4. Verify edge details on shop drawings before commencing.
  5. Applied facings shall be factory bonded where practicable. Fully faced doors shall be factory matched with door-frames to minimize requirement for site adjustment.
  6. Use water-resistant adhesive or other suitable concealed methods. No mechanical fixings shall be visible in the completed work. Finish exposed edges with smooth edges.
  7. Unless otherwise indicated, width of applied facings shall be full width of door. Width may be reduced to clear doorstops, if approved before commencing.
  8. Kick plates shall be satin stainless steel, 178mm to 406mm height as specified.
  9. Armour Plates shall be satin stainless steel, 940mm to 1220mm height as specified.
  10. Mop Plates shall be satin stainless steel, 150mm height.
  11. Stretcher plate shall be satin stainless steel, 150mm height or as specified.
  12. Push Plates shall be manufactured from the specified finish indicated in this document. All plates to be 1.6mm thick and shall be fixed with flush countersunk screws located 5mm from the edge corner. Eurolever Model Collection SS25315. The plates shall have square edges.
- K. Exit Devices:
1. Exit Devices shall be approved proprietary types, suitable for the location and the intended function, in accordance with the Product Information.



2. Submit product information, and Control Samples if directed.
  3. Exit devices to be Dorma 4000 series without side trim suitable for Euro profile cylinder.
  4. Exit devices to conform to EN 1125, (EN 13633 for Electronic panic devices). Exit devices to be full length touch bar in satin stainless steel finish. The touch bar, rail and chassis cover to be in true architectural finish.
  5. Single doors to have rim type while double doors to have vertical rod exit devices either concealed or surface mounted as specified, with trim outside on the active leaf. All doors leading from lobbies to staircases and staircase to the exit should have exit devices. For vertical rod exit devices there should be option available 'Less bottom rods' where the bottom rods may be damaged by trolleys etc. due to the type of usage of door.
  6. Exit devices for non-fire rated door to have dogging option if required. For fire rated doors if required panic devices to be magnetically dogged. The dogging should release upon activation from the fire alarm systems or interruption of power supply. Exit devices for fire rated doors to be CE Marked.
  7. For locations where Delayed egress exit device is required, use. Device to have Delayed egress, Nuisance Alarm, Local or Remote alarm, Indicator LED, Key switch Control, Remote authorized egress, Remote rearm, and door position input. The Delayed egress exit device to be listed by U.L. under continuing re-inspection programs and conforms to the standards U.L. 10C and U.B.C. 7-2 positive pressure testing. The Delayed egress exit device to be Certified by BHMA to the requirements of ANSI A156.3 for Grade 1 exit devices.
- L. Surface Bolts/Flush Bolts Coordinators:
1. Surface bolts/flush bolts will be required to lock inactive leaves on pairs of doors. All bolts shall be UL labelled, suitable for fire door application.
- M. Door Pulls:
1. Door Pulls for handicapped WC shall be 300mm long 20mm dia. In stainless steel, 630 finish.
  2. Executive private (22 level) shall be 30mm dia 350mm long offset pull handle with back to back fixing. Same pull handle type shall be used at ground floor entry.
- N. Weather-stripping:
1. All exterior doors shall have complete perimeter weather-stripping mechanically fixed to stiles/rails. Aluminium as well as metal doors shall have jamb header seal for stiles/rails and vinyl bottom sweeps. Type and details of fixation shall be clearly indicated for Kahramaa's approval.
- 3.6.7.3 PART 3 - EXECUTION**
- 1.1. EXAMINATION
- A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.
- 1.2. INSTALLATION
- A. The contractor shall appoint an individual who will be responsible for receiving of hardware and its storage, security and installation for the entire project.



- B. The Contractor shall check the hardware on installation for correct operation, maintain each item in accordance with the Manufacturer's instructions, protect it against damage by other trades and adjust, clean and lubricate it on completion of the Works.
- C. The Contractor shall not fix hardware until background finishes are complete. Hardware previously fixed shall be removed before any finishing process.
- D. Install hardware in accordance with manufacturer's instructions and applicable codes.
- E. Use templates provided by hardware item manufacturer.
- F. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
- G. Mounting heights for hardware from finished floor to centre line of hardware item;
  - 1. Butts.
    - a. Door 1520mm or less in height provide 2 hinges or as noted on schedule.
  - 2. Strikes for locks and latches.
    - a. 1024mm from bottom of frame.
  - 3. Push and Pull Units.
    - a. 1070mm from bottom of frame.
  - 4. Deadlocks.
    - a. 1520mm from bottom of frame.
  - 5. Exit Devices.
    - a. 1024mm from floor to centreline of cross bar or push pad.
  - 6. Door closers and door holders.
    - a. Degrees of openings as noted in hardware schedule.
  - 7. Provide assistance and supervision of installation when requested.

### **3.1. ADJUSTING**

- A. Adjust work under provisions of Section 017000.
- B. Adjust hardware for smooth operation.

### **3.2. PROTECTION**

- A. Protect finished Work under provisions of Section 017000.
- B. Do not permit adjacent work to damage hardware or finish.

### **3.3. SCHEDULE**

- A. Refer to Ironmongery Schedule included in specification appendices.

## **3.6.8 SECTION 08 80 00 – GLAZING**

### **3.6.8.1 PART 1 - GENERAL**

#### **1.1. RELATED DOCUMENTS**

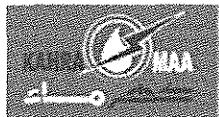
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2. SUMMARY**

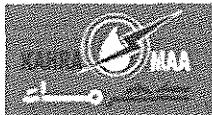
- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:



1. Windows.
  2. Doors.
  3. Aluminium Framed Glass Doors
  4. Aluminium Framed Entrances and Storefronts
  5. Curtain Wall refer to Façade Specifications
- B. Related Sections:
1. Section 081113 "Hollow Metal Doors and Frames" for glazing requirements.
  2. Section 081216 "Aluminium Doors and Frames" for glazing requirements.
- C. Related Schedules:
1. Door Schedule
  2. Window Schedule
- 1.3. DEFINITIONS**
- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimetres according to ASTM C 1036.
- C. Interspace: Space between lights of an insulating-glass unit.
- 1.4. PERFORMANCE REQUIREMENTS**
- A. As an alternative to the American standards generally listed within this specification, contractors may demonstrate compliance with the UK standards set within latest edition of the Centre for Window and Cladding Technology 'Standard for Curtain Walling' (hereinafter abbreviated to CWCT Standard) unless specified otherwise in this section.
1. If referencing the CWCT standards, keep a copy of the CWCT Standard at the design office, workshop and on site, readily accessible for reference at all times during the course of the works.
  2. Comply with CWCT Performance Criteria unless specified or agreed otherwise.
- B. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
1. Design Wind Pressures: As calculated from basic wind speed and heights above grade indicated on Drawings.
    - a. Basic wind speed: 45m/s
  2. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:
    - a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
    - b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
    - c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.



3. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  4. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.008.
  5. Maximum Lateral Deflection: For glass supported on all four edges, limit centre-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 20mm, whichever is less.
  6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lights.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
1. Temperature Change: 67 deg C, ambient; 100 deg C, material surfaces.
- 1.5. PRECONSTRUCTION TESTING
- A. Preconstruction Adhesion and Compatibility Testing Adhesion (for insulating or laminated glass installed with glazing sealants): Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
    1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
    2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
    3. Test no fewer than eight samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
    4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
    5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures.
- 1.6. SUBMITTALS
- A. Product Data: For each glass product and glazing material indicated.
  - B. Glass Samples: For each type of glass product other than clear monolithic vision glass. 300mm square.
    1. Tinted glass
    2. Coated glass.
    3. Laminated glass.
    4. Insulating glass.
  - C. Glazing Accessory Samples: For gaskets, sealants and coloured spacers, in 300mm lengths. Install sealant samples between two strips of material representative in colour of the adjoining framing system.
  - D. Glazing Schedule: List glass types, determined heat treatment and thicknesses for each size opening and location. Use same designations indicated on Drawings.
  - E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.



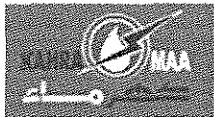
- F. Qualification Data: For installers, manufacturers of insulating-glass units with sputter-coated, low-e coatings glass testing agency and sealant testing agency.
- G. Product Certificates: For glass and glazing products, from manufacturer.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass, coated glass, insulating glass, glazing sealants and glazing gaskets.
  - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36- month period.
- I. Preconstruction adhesion and compatibility test report.
- J. Warranties: Sample of special warranties.

#### **1.7. QUALITY ASSURANCE**

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-ECoatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified in accordance with glass and aluminium framing manufacturer's requirements and those of local authorities having jurisdiction.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program or approved European equivalent.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 (or approved European equivalent) to conduct the testing indicated.
- E. Source Limitations for Glass: Obtain tinted float glass, coated float glass, laminated glass and insulating glass from single source from single manufacturer for each glass type.
- F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. BS5516-1:2004: Patent glazing and sloping glazing for buildings. Code of practice for design and installation of sloping and vertical patent glazing.
  - 2. BS 5516-2:2004: Patent glazing and sloping glazing for buildings. Code of practice for sloping glazing.
  - 3. BS 6262-2:2005: Glazing for Buildings. Code of practice for energy, light and sound.
  - 4. BS 6262-3:2005: Glazing for Buildings. Code of practice for fire, security and wind loading.
  - b. BS 6262-4:2005: Glazing for Buildings. Code of practice for safety relating to human impact.
  - c. BS 6262-5:2005: Glazing for Buildings. Code of practice for frame design considerations. AND / OR
  - d. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
  - e. AAMA Publications: AAMAGDSG-1, "Glass Design for Sloped Glazing," and AAMATIR-A7, "Sloped Glazing Guidelines."
  - f. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  - g. IGMA Publication for Insulating Glass: SIGMATM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."



- H. Safety Glazing Labelling: Where safety glazing labelling is indicated, it must be clearly and indelibly marked, in a position that can be clearly seen after installation, with the following information:
  - 1. The name or trademark of the manufacturer, merchant or installer.
  - 2. The identifier of the product standard that the product standard that the safety glass conforms to: eg BS EN 12150; BS EN 14179; BS EN 14449.
- I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component light of units with appropriate certification label of IGCC.
- J. Mock-ups: Build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Install glazing in mock-ups specified in specification sections listed below to match glazing systems required for Project, including glazing methods.
    - a. Division 05 Section "Decorative Metal Railings" for glass panels in railings.
    - b. Division 08 Section "Curtain wall, framed entrances and windows."
    - c. Division 08 Section "Metal-framed skylights and sloped, glazed roofs."
- 1.8. DELIVERY, STORAGE & HANDLING
  - A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
  - B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change if glass is to be flown to site.
- 1.9. PROJECT CONDITIONS
  - A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
    - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 4.5 deg C.
- 1.10. WARRANTY
  - A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
    - 1. Warranty Period: 10 years from date of Substantial Completion.
  - B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from poor manufacturing processes, normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
    - 1. Warranty Period: 10 years from date of Substantial Completion.



- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorates within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

#### **3.6.8.2 PART 2 - PRODUCTS**

##### **1.1. GLASS PRODUCTS GENERAL**

- A. Thickness: Where glass thickness is indicated, it is a minimum. 6mm is overall minimum for all glass. Provide glass lights in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat treated float glass.
- C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic-protection testing requirements in ASTME1996 for Wind Zone 1 when tested according to ASTME1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
  - 1. Large-Missile Test: For glazing located within 9m of grade.
  - 2. Small-Missile Test: For glazing located more than 9m above grade.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. For monolithic-glass lights, properties are based on units with lights of thickness indicated.
  - 2. For laminated-glass lights, properties are based on products of construction indicated.
  - 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each light.
  - 4. U-Values: Centre-of-glazing values, according to NFRC100 or BS6262-2:2005: Glazing for Buildings Code of practice for energy, light and sound, expressed as W/sq. m x K.
  - 5. Solar Heat-Gain Coefficient and Visible Transmittance: Centre-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program or BS 6262-2:2005: Glazing for Buildings. Code of practice for energy, light and sound,
  - 6. Visible Reflectance: Centre-of-glazing values, according to NFRC 300.

##### **1.2. GLASS PRODUCTS**

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.



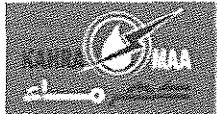
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
  2. For uncoated glass, comply with requirements for Condition A.
  3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- 1.3. **LAMINATED GLASS**
- A. Manufacturers: Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer. Substitutions: See Section 016000 - Product Requirements.
  - B. Laminated Glass: ASTMC 1172, and complying with testing requirements in 16 CFR1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolour, or lose physical and mechanical properties after fabrication and installation.
    1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
    2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
    3. Interlayer Colour: Clear unless otherwise indicated.
  - C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.
- 1.4. **INSULATING GLASS**
- A. Manufacturers: Pilkington or a recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer. Substitutions: See Section 016000 - Product Requirements.
  - B. Insulating-Glass Units: Factory-assembled units consisting of sealed lights of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
    1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
    2. Spacer: Aluminium with black, colour anodic finish.
    3. Desiccant: Molecular sieve or silica gel, or blend of both.
  - C. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated- Glass Types" Article.
- 1.5. **GLAZING GASKETS**
- A. Dense Compression Gaskets: Moulded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
    1. EPDM complying with ASTM C 864.
    2. Silicone complying with ASTM C 1115.



- 3. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTMC 509, Type II, black; of profile and hardness required to maintain watertight seal.
  - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

#### **1.6. GLAZING SEALANTS**

- A. General:
  - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  - 3. Colours of Exposed Glazing Sealants: As selected by Engineer from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 790.
    - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
    - c. May National Associates, Inc.; Bondaflex Sil 290.
    - d. Pecora Corporation; 890.
    - e. Sika Corporation, Construction Products Division; SikaSil-C990.
    - f. Tremco Incorporated; Spectrem 1.
  - 2. Applications: As recommended by glazing manufacturer / installer.
- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BASF Building Systems; Omnisil 50.
    - b. Dow Corning Corporation; 756 SMS, 791, 795, 995.
    - c. GEAdvanced Materials - Silicones; SilGlaze IISCS2800, SilPruf NBSCS9000, SilPruf SCS2000, UltraPruf II SCS2900.
    - d. May National Associates, Inc.; Bondaflex Sil 295.
    - e. Pecora Corporation; 864, 895, 898.
    - f. Polymeric Systems, Inc.; PSI-641.



- g. Sika Corporation, Construction Products Division; SikaSil-C995.
  - h. Tremco Incorporated; Spectrem 2 or Spectrem 3.
  - i. Compliant alternatives may be submitted to the Engineer for approval.
2. Applications: As recommended by glazing manufacturer / installer.
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 799.
    - b. GE Advanced Materials - Silicones; UltraGlaze SSG4000, UltraGlaze SSG4000AC.
    - c. May National Associates, Inc.; Bondaflex Sil 200 GPN, Bondaflex Sil 201 FC.
    - d. Polymeric Systems, Inc.; PSI-631.
    - e. Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Plus.
    - f. Mapei : Mapesil AC
    - f. Tremco Incorporated; Proglaze SSG, Tremsil 600.
    - g. Compliant alternatives may be submitted to the Engineer for approval.
  - 2. Applications: As recommended by glazing manufacturer / installer.
- E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTMC 920, Type S, Grade NS, Class 25, Use NT.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BASF Building Systems; OmniPlus.
    - b. Bostik, Inc.; Chem-Calk 1200.
    - c. Dow Corning Corporation; 999-A.
    - d. GE Advanced Materials - Silicones; Contractors SCS1000, Construction SCS1200.
    - e. May National Associates, Inc.; Sil 100 GC, Sil 100 GP, Sil 100 WF.
    - f. Pecora Corporation; 860.
    - g. Polymeric Systems, Inc.; PSI-601.
    - h. Schnee-Morehead, Inc., an ITW company; SM5732 Polyglaze.
    - i. Tremco Incorporated; Proglaze, Tremsil 200.
    - j. Compliant alternatives may be submitted to the Engineer for approval.
  - 2. Applications: As recommended by glazing manufacturer / installer.
- 1.7. GLAZING TAPES
- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
- 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:



1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

#### **1.8. MISCELLANEOUS GLAZING MATERIALS**

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lights in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labelled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

#### **1.9. FABRICATION OF GLAZING UNITS**

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

#### **1.10. LAMINATED-GLASS TYPES**

- A. Glass Type GL-01: Clear laminated glass with two plies of heat-strengthened float glass.
  1. Thickness of Each Glass Ply: 6.0 mm or as per Manufacturer's Recommendation.
  2. Interlayer Thickness: As per Manufacturer's Recommendation.
  3. Provide safety glazing labelling.

#### **1.11. INSULATING-LAMINATED-GLASS TYPES**

- A. Glass Type GL-02: Low-e-coated, tinted, insulating laminated glass.
  1. Overall Unit Thickness: 25 mm.
  2. Thickness of Outdoor Lite: 6.0 mm.
  3. Outdoor Lite: Tinted heat-strengthened float glass.
  4. Interspace Content: 13mm Argon.
  5. Indoor Lite: Clear laminated glass with two plies of float glass.
    - a. Thickness of Each Glass Ply: 3.0 mm.



- b. Interlayer Thickness: 1.52 mm.
- 6. Low-E Coating: Pyrolytic on second surface.
- 7. Visible Light Transmittance: 29% minimum.
- 8. Winter Night-time U-Factor: 1.70 W/m<sup>2</sup> maximum.
- 9. Summer Daytime U-Factor: 1.70 W/m<sup>2</sup> maximum.
- 10. Solar Heat Gain Coefficient: 0.33 maximum.
- 11. Provide safety glazing labelling.

#### **3.6.8.3 PART 3 - EXECUTION**

##### **1.1. EXAMINATION**

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

##### **1.2. PREPARATION**

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

##### **1.3. GLAZING, GENERAL**

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.



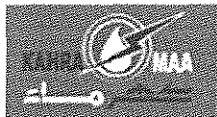
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lights.
- G. Provide spacers for glass lights where length plus width is larger than 1250mm.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 3mm minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lights from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lights in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lights with proper orientation so that coatings face exterior or interior as specified.

#### 1.4. TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Centre glass lights in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

#### 1.5. GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints mitre cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Centre glass lights in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.



- D. Installation with Pressure-Glazing Stops: Centre glass lights in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

#### **1.6. SEALANT GLAZING (WET)**

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lights and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

#### **1.7. CLEANING & PROTECTION**

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

### **3.6.9 SECTION 08 90 00 – LOUVERS AND VENTS**

#### **3.6.9.1 PART 1 - GENERAL**

##### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2. SUMMARY**

- A. Section Includes:



1. Fixed, extruded-aluminium and formed-metal louvered doors.
  2. Fixed, extruded-aluminium and formed-metal louvers.
- B. Related Sections:
1. Section 081133 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
  2. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.
  3. MEP Sections for louvers that are a part of mechanical equipment.
  4. MEP Section "Instrumentation and Control for HVAC" for electric, electronic, and pneumatic control of adjustable louvers.
  5. MEP Sections for electrical power connections for motor-operated adjustable louvers.
- C. Related Schedules:
1. Door Schedule
- 1.3. **DEFINITIONS**
- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
  - B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
  - C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
  - D. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.
- 1.4. **PERFORMANCE REQUIREMENTS**
- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
    1. Wind Loads: Determine loads based on the stated design wind speed of 45m/s acting on externally located louvers
  - B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to the buildings locations within designated seismic zone of 2A.
  - C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
    1. Temperature Change (Range): 67 deg C, ambient; 100 deg C material surfaces.
  - D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- 1.5. **SUBMITTALS**
- A. Product Data: For each type of product indicated.



1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
  1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
  2. Show mullion profiles and locations.
- C. Samples for Verification: For each type of metal finish required.
- D. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

#### **1.6. QUALITY ASSURANCE**

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied colour finish.

#### **1.7. PROJECT CONDITIONS**

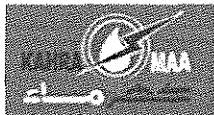
- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

#### **3.6.9.2 PART 2 - PRODUCTS**

##### **1.1. MATERIALS**

- A. Aluminium Extrusions: ASTM B 221M, Alloy 6063-T5, T-52, or T6.
- B. Aluminium Sheet: ASTMB 209M, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminium Castings: ASTM B 26/B 26M, Alloy 319.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M Z180 or Z275 zinc coating, mill phosphatized.
- E. Fasteners: Use types and sizes to suit unit installation conditions.
  1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
  2. For fastening aluminium, use aluminium or 300 series stainless-steel fasteners.
  3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
  4. For fastening stainless steel, use 300 series stainless-steel fasteners.
  5. For colour-finished louvers, use fasteners with heads that match colour of louvers.
- F. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

##### **1.2. FABRICATION GENERAL**



- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
  - B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
    - 1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern where indicated.
    - 2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated 02.02.C
  - C. Maintain equal louver blade spacing, to produce uniform appearance.
  - D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
    - 1. Frame Type: Channel unless otherwise indicated.
  - E. Include supports, anchorages, and accessories required for complete assembly.
  - F. Provide vertical mullions of type and at spacing indicated, but not more than recommended by manufacturer, or 1800mm o.c., whichever is less.
    - 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
    - 2. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
  - G. Provide subsills made of same material as louvers or extended sills for recessed louvers.
  - H. Join frame members to each other and to fixed louver blades with concealed fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.
- 1.3. PROPRIETARY ALUMINIUM LOUVRED DOORS
- A. Proprietary louvered door sets for plant rooms & substations. Provide hinged louvered panels where required, as scheduled and in conformance with the standards of local electrical authorities.
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Subject to compliance, approved equivalent products and manufacturers may be submitted to the Engineer for approval.
    - 2. Louver Depth: manufacturer's standard
    - 3. Frame and Blade Nominal Thickness: manufacturer's standard.
    - 4. Hardware: Standard locks and hardware in accordance with the requirements of the local authority/utility company having jurisdiction. Door to be complete with heavy duty hinges, aluminium aldop locking hook, handles and additional locking hasp.



5. Construction: Heavy duty, each section adequately braced at back. Door is secured to frame with heavy duty brass tower bolts.
6. Louver Performance Ratings:
  - a. Free Area: Not less than 50% of overall louver area.
7. Finish: High-Performance Organic Finish.

#### **1.4. FIXED EXTRUDED ALUMINIUM LOUVRES**

##### **A. Horizontal, Drainable-Blade Louver.**

1. Manufacturers: Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer. Substitutions: See Section 016000 - Product Requirements.
2. Louver Depth: Nom 100mm
3. Blade Profile: Manufacturer's standard.
4. Frame and Blade Nominal Thickness: Not less than 2mm for blades and 2mm for frames.
5. Mullion Type: Exposed or Semi-recessed,
6. Louver Performance Ratings:
  - a. Free Area: Not less than 50% of overall louver area.
  - b. Air Performance: Not more than 25Pa static pressure drop at 4m/s free-area intake velocity.
7. Finish: High-Performance Organic Finish.

#### **1.5. LOUVRE SCREENS**

##### **A. General: Provide screen at louvers.**

1. Screen Location for Fixed Louvers: Interior face (behind louver).
2. Screening Type: Bird screening.

##### **B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 150 mm from each corner and at 300mm o.c.**

##### **C. Louver Screen Frames: Fabricate with mitred corners to louver sizes indicated.**

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminium screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Non-rewirable, U-shaped frames.

##### **D. Louver Screening for Aluminium Louvers:**

1. Bird Screening: Aluminium, 13mm square mesh, 1.5mm wire.

##### **E. Louver Screening for Galvanized-Steel Louvers:**

1. Bird Screening: Galvanized steel, 13mm square mesh, 1.0mm wire.

#### **1.6. BLANK-OFF PANELS**

##### **A. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.**

1. Aluminium sheet for aluminium louvers, not less than 1.25mm nominal thickness.
2. Galvanized-steel sheet for galvanized-steel louvers, not less than 1.0mm nominal thickness.



3. Panel Finish: Same type of finish applied to louvers, but black colour.
4. Attach blank-off panels with clips or sheet metal screws.

#### **1.7. FINISHES GENERAL**

- A. Comply with NAAMM's "Metal Finishes Manual for Engineer and Metal Products" for recommendations for applying and designating finishes.

#### **1.8. ALUMINIUM FINISHES**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- B. Colour Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  1. Colour: As selected by Engineer from full range of industry colours and colour densities.
- C. High-Performance Organic Finish: System consisting of single fluoropolymer colour coat, complying with AAMA 2605, consisting of PVF3 powder resin. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  1. Colour and Gloss: As selected by the Engineer from manufacturer's full range
  2. Basis-of-Design Product: Subject to compliance with requirements, provide Jotun Corrocoat PVF3 Durasol or comparable product with the approval of the Engineer.

#### **1.9. GALVANIZED-STEEL SHEET FINISHES**

- A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.
- B. High-Performance Organic Finish: System consisting of single fluoropolymer colour coat, complying with AAMA 2605, consisting of PVF3 powder resin. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  1. Colour and Gloss: As selected by the Engineer from manufacturer's full range
  2. Basis-of-Design Product: Subject to compliance with requirements, provide Jotun Corrocoat PVF3 Durasol or comparable product with the approval of the Engineer.

#### **3.6.9.3 PART 3 - EXECUTIONS**

##### **1.1. EXAMINATION**

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

##### **1.2. PREPARATION**

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

##### **1.3. INSTALLATION**

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.



- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

#### **1.4. ADJUSTING AND CLEANING**

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Engineer, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches colour and gloss of, and is compatible with, factory-applied finish coating.

### **3.7 DIVISION 09 FINISHES**

#### **3.7.1 SECTION 09 22 16 – NON-STRUCTURAL METAL FRAMING**

##### **3.7.1.1 PART 1 - GENERAL**

###### **1.1. SECTION INCLUDES**

- 1. Metal lath for Portland cement plaster.
- 2. Furring for metal lath.
- 3. Metal ceiling framing.
- 4. Access panels.

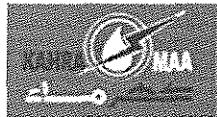
###### **1.2. RELATED REQUIREMENTS**

###### **A. Related Requirements:**

- 1. Section 092400 - Portland cement Plaster.
- 2. Section 093000 - Tiling.



3. Section 092900 - Gypsum Board.
- 1.3. REFERENCE STANDARDS**
- A. Related Standards:
1. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  2. ASTMA 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  3. ASTM A 568/A 568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements.
  2. ASTMA 641/A 641M- Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  3. ASTMA 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  4. ASTM C 645 - Standard Specification for Nonstructural Steel Framing Members.
  5. ASTM C 1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
  6. ASTM C 841 - Standard Specification for Installation of Interior Lathing and Furring.
  7. ASTM C 847 - Standard Specification for Metal Lath.
  8. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2006.
  9. BS EN 10244-2, Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Zinc or zinc alloy coatings.
  10. BSENISO1461, hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
  11. 13. BS1369-1, Steel lathing for internal plastering and external rendering. Specification for expanded metal and ribbed lathing.
  12. BS 1494-1, Specification for fixing accessories for building purposes. Fixing for sheet, roof and wall coverings.
  13. BS EN 10143, continuously hot-dip metal coated steel sheet and strip. Tolerances on dimensions and shape.
  14. BS EN 10162, Cold rolled steel sections. Technical delivery conditions. Dimensional and cross-sectional tolerances.
- 1.4. SUBMITTALS**
- A. See Section 013000 - Administrative Requirements, for submittal procedures.
  - B. Shop Drawings. Submit shop drawings of framing system installation details and brochures illustrating materials intended for installation.
  - C. Product Data provide data on furring and lathing components, structural characteristics, material limitations and finish.
  - D. System Data, submit structural design data to verify that framing systems, anchorage, fasteners, hangers and anchors meet requirements for each system.
  - E. Samples, submit to site;
    1. 300mm long samples of framing members and furring;



2. 300mm x 300mm samples of lath and individual accessories including ceiling hanger insert.
  - F. Affidavits. Submit affidavits that materials specified by reference standards and supplied for project meet specified requirements, if requested.
- 1.5. **QUALITY ASSURANCE**
- A. Provide framing, lath, reinforcement and accessories for mock-ups.
  - B. Fire Rated Assemblies: Provide components complying with requirements for fire rated assemblies.
  - C. Coordinate with and assist Section 072100, Thermal Insulation, to locate Zee bar fasteners provided by Section 072100 for insulation suitable for both work of this Section and Section 072100.
- 1.6. **DELIVERY, STORAGE AND HANDLING**
- A. Handle and store materials to prevent damage and rusting.

### 3.7.1.2 PART 2 - PRODUCTS

#### 1.1. MANUFACTURERS

- A. Metal Lath:
  1. Approved Manufacturer:
  2. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  3. Substitutions: See Section 016000 - Product Requirements.

#### 1.2. MATERIALS

- A. Fabricate formed cold rolled steel members to meet specified requirements of ASTM A568M or BS EN 101162.
- B. Galvanizing:
  1. Formed Cold Rolled Steel Members. To meet specified requirements of ASTM A653/A653M Z275 zinc coating designation; or of BSEN10143, G275 zinc coating designation.
  2. Accessories. Hot dip zinc coating to meet specified requirements of ASTM A123 or of BS EN ISO 1461.
  2. Wire and Rods. To meet specified requirements of ASTM A116, Class 3 zinc coating.
  3. Hardware and Bolts. To meet specified requirements of ASTM A153/ A153M.
- C. Furring/Framing members:
  1. Runner Channels. Formed and galvanized of minimum 1.5mm thick cold rolled steel core, minimum 38mm deep, with minimum 14mm wide flanges.
  2. Furring Channels. Formed and galvanized of minimum 1.5mm thick cold rolled steel core, minimum 19mm deep, with minimum 36mm wide flanges.
- D. Metal Studs:
  1. Studs. Formed and galvanized of minimum 0.8mm thick cold rolled steel core, of depth indicated on drawings and to meet specified requirement of ASTMC645 or equivalent Trussteel Studs by United States Gypsum Company.
  2. Stud Track and Bracing. Formed channels of galvanized cold rolled steel manufactured as for studs.
- E. Fixings:



1. To meet specified requirements of ASTM C841 or C1063 as applicable, or of BS 1494, Part 1; galvanized.
  - F. Wire:
    1. Hangers. Galvanized steel to meet specified requirements of ASTMC641/A641M, or equivalent steel rod.
    2. Tie Wire. Galvanized annealed steel to meet specified requirements of ASTMA116. Minimum 1.626mm.
  - G. Metal Lath:
    1. Expanded galvanized steel to meet specified requirements of ASTM C847 or of BS 1369-1 a. For Portland cement Plaster, USG Expanded Metal Stucco mesh by United States Gypsum Company, 1.95 kg/sq.m, or equivalent as approved.
- 1.3. ACCESSORIES**
- A. Access Panels: As specified in Section 083113.
  - B. Incorporate only types of accessories to suit plaster system thickness.
    1. Provide accessories manufactured of 0.54mm thick galvanized steel with 50mm expansion wings unless otherwise specified.
    2. Expansion Joint. Formed metal bellows type with expanded metal flanges; USG Expansion Joint # 15 by United States Gypsum Company, or equivalent as approved.
    2. Casing Bead. Square with expanded flange, USG Metal Trim No. 701-Aby United States Gypsum Company, or equivalent as approved.
    3. 4. Corner Bead. Standard fine bead with 70mm expanded flange, USG1-AExpanded Corner Bead by United States Gypsum Company, or equivalent as approved.
  - C. Hanger Anchors:
    1. Install expansion bolt sleeves in drilled holes to provide anchors for threaded eyes or hanger rods of size and type to support total load of ceiling and other components supported by ceiling.
  - D. Ceiling Framing Hangers:
    1. Galvanized steel rod, or threaded galvanized steel rod suitable for inserts and of sufficient diameter to support ceiling and in any case 5mm minimum dia.
  - E. Flush Face Access Doors:
    1. 610 x 610mm or larger where required recessed type.
    2. Inryco/Milcor Flush Panel Access Doors, Style DW, having 16 gauge galvanized steel door and 12 gauge galvanized steel frame with concealed continuous piano type hinged, with screwdriver latch with Allen head, as indicated on architectural drawings and where required to access equipment.
    2. Access door assembly to have fire rating equivalent to the rating of the wall partition or ceiling assembly in which it is installed. Fire rated access doors shall conform to the requirements of NFPA 80, NFPA 252 and UL 10B.
    3. Flush face access doors by Inryco Inc. or Le Hage Industries Limited or Wilkinson Company Inc., or equivalent approved.

**3.7.1.3 PART 3 - EXECUTION**



### 1.1. EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrates are ready to receive work and conditions are suitable for application.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

### 1.2. INSTALLATION - GENERAL

- A. Install interior lath and furring in accordance with ASTM C 841.
- B. Install lath and furring for plaster work in accordance with ASTM C 841 and GA-600.

### 1.3. INSTALLATION OF FRAMING, LATH AND REINFORCEMENT.

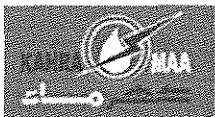
- A. Framing and furring shown on drawings is indicative, but should not be regarded as exact or complete. Install framing for lath and plaster indicated on drawings wherever no other plaster base is installed, as suitable for plaster system.

#### B. Hangers for Suspended Framing Systems

- 1. Install hangers at maximum spacing of 1000mm on centre along length of runner channels and to suit conditions otherwise and within 150mm of ends of runner channels.
- 2. Provide hangers of sizes as follows to support listed weights:

Weight supported	Minimum diameter per hanger in kg.of hanger in mm
40	3.0
55	3.5
60	4.0
78	4.5
110	5.0

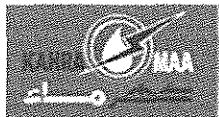
- 3. Assume weight of suspended plaster system at 50 kg/sq.m for framing, furring, lath and plaster. Obtain weight of other components supported by plaster system from their installers.
- 4. Install expansion bolt sleeves in drilled holes for ceiling hangers.
- 5. Secure threaded hangers or eyebolts to anchors, locked in place to prevent loosening by vibration. Where eyebolts are used, tie hangers securely to eyebolts.
- 6. Bend hangers sharply at right angles below runner channels.
- 7. Secure hangers to runner channels by saddle tying lower end of hangers to channels with not less than three strands of minimum 1.2 dia. Tie wire.
- C. Provide framing system and lath of adequate strength to withstand stresses imposed by use without distortion and to maintain dimensions and contours indicated on drawings. Include bracing for furring and studs.



- D. Erect materials located at dimensions indicated on drawings, plumb, level, and straight and square to adjoining elements.
- E. Do not install metal framing, trim, casings, or other accessories which have been bent, dented or otherwise deformed.
- F. Provide for movement at intersections with structural members to avoid transference of loads to plastering systems.
- G. Do not support plastering system from, nor make attachments to, ducts, pipes, conduit, or the support framing of the installations of other sections.
- H. Do not install furring or lath in close proximity to hot pipes or to heating ducts.
- I. Make allowance for thermal movements in plastering systems.
- J. Install Control Joints.
  - 1. For interior gypsum plaster walls and ceilings spaced no greater than 9m in each direction, or as otherwise indicated.
  - 2. For cement plaster spaced at a maximum of 3m, arranged in a pattern of areas not exceeding 10sq.m.
  - 2. Formed with two square casing beads spaced 3mm apart, with flexible membrane providing air seal, and secured to independent framing at each side of joint.
  - 3. Line up control joints with joints in other construction, or with centre lines of mullions, columns, piers, or similar building elements, or as indicated on drawings.
- K. Install suspended ceiling framing independent of walls, columns, facings, ducts, and pipes.
- L. Install framing for support and incorporation of flush-mounted and recessed mechanical and electrical equipment. Ensure adequacy of supports by consultation and verification of methods.
- M. Coordinate installation of plaster rings for electrical fixtures.
- N. Framing and Furring Systems.
  - 1. Do not use wood blocking or furring.
  - 2. Install runner channels for suspended plaster systems at maximum spacing of 1000mm between channels, within 150mm from ends of furring channels that are secured to runner channels and within 150mm of parallel walls or other construction. Ends of runner channels shall not come into contact with abutting walls or other construction.
  - 3. Install furring channels for metal lath at maximum spacing of 400mm between channels, to span no greater than 1000mm, within 150mm of adjacent parallel construction and within 25 mm of (but not in contact with) abutting construction.
  - 4. Splice runner channels by overlapping at least 300mm and wrap with two strands of minimum 1.6mm dia. Tie wire at 50mm from each end of the overlap.
  - 5. Splice furring channels to be nesting and overlapping at least 200mm and wrap with two strands of minimum 1.6mm dia. tie wire at 25mm from each end of the overlap.
  - 6. Secure furring channels to runner channels with double strand loops of minimum 1.6mm tie wire.
  - 7. Do not line up or cluster splices in runner or furring channels.
  - 8. Do not locate splices in furring channels at same location as splices in runner channels.



9. Frame openings on all sides with suitable sections. Provide clearances required at mechanical and electrical services, such as grilles, diffusers, access panels and lighting fixtures only after verification of requirements in each case.
  10. Where wall furring is shown clear of wall on drawings, construct framing as for metal stud partitions.
  11. Shop fabricate curved furring channels.
- O. Metal Stud Framing.
1. Secure runner channels at floor and tops of partitions for their full length, at 600mm on centre with concrete nails, square cut nails, toggle bolts, or sheet metal screws as suitable for base material. Install runner channels also at heads and sills of openings. Secure runners at openings by cutting flanges, turning up webs and screwing to studs.
  2. Provide partition runners with deep flanges at heads of partitions where deflection and/or creep of structure will occur.
  3. Butt, do not miter, runners at wall intersection and corners. Lap runners and screw channels together.
  4. Space studs at 400mm on centre and at no greater distance than 50mm from abutting walls, partitions and corners.
  5. Secure studs to runners by screws, crimping, or welding, as required by stud type and in accordance with manufacturer's design specification. Include provisions for deflection of building structure to ensure that structural loads are not transferred to studs.
  6. Double studs at door jambs. At each jamb of doors exceeding either 900mm in width or 57mm in thickness, or both, install a 100mm hot rolled structural channel, to structure above and adequately anchored at each end.
  7. Erect three studs at corner and intermediate intersections of partitions.
  8. Install partition runners at heads and sills of openings in partitions. Form 150mm bends in runners and secure bent portion to studs.
  9. Screw, or weld, frame anchor clips, of frames, to jamb studs, and head and sill runners. Ensure adequate fastening to prevent movement of the frame within the partition. Remove spreaders at floor after frames are anchored.
- P. Metal Lath.
1. Install sheets of metal lath with the long dimension parallel to its support framing. Offset ends of sheets from adjoining sheets wherever possible, and support ends on a framing member wherever possible.
  2. Lap lath 13mm at sides of sheets and 25mm at ends.
  3. Secure side laps of sheets to supports with wire ties spaced at no more than 150mm on
  4. Wire tie side laps of sheets between supports at no more than 150mm o.c.
  5. Lace or tie together end laps of sheets with minimum 1.2mm dia. tie wire.
  6. Where lath is installed on a solid backing, ensure that a space of at least 6mm is provided between the solid surface and the back of the lath to provide a key for the plaster.



7. Install screeds at junctions between plaster and tile work. Lay out in cooperation with tile setter. Do not install lath in contact with or attached to installations of others unless otherwise indicated or specified.
8. Incorporate a slip joint of building paper or polyethylene sheet between lath and faces of structural members upon which plaster is installed.
9. Do not install lath continuously behind expansion or control joints.

#### **1.4. ACCESSORIES.**

- A. Install accessories in full lengths of 3m minimum wherever possible, with no lengths under 1800mm, with tightly mitered joints at corners and otherwise tightly formed and butted, with no rough edges exposed or at joints and only of dimensions to suit plaster thickness.
- B. Fasten accessories to metal lath with wire ties at 200mm on centre.
- C. Install corner beads at horizontal and vertical external corners.
- D. Install square casing beads at edges of plastered surfaces that abut other materials whether covered by trim or not.
- E. Install square casing beads at perimeters of suspended ceilings where they abut walls and other vertical surfaces, whether of plaster or not.

#### **1.5. TOLERANCES**

- A. Install finish plaster and lath to ensure that, within a tolerance of + 3mm and -2mm for plaster thickness, finish surfaces are flat or smoothly curved as the case may be and that surface planes are within 3mm of dimensioned location. Finish plasters flush with grounds, beads and casings.
- B. Install framing members to ensure that deflection of each member does not exceed 1/360 of its span under dead load and loads imposed by mechanical and electrical equipment and fixtures supported by the ceiling.

### **3.7.2 SECTION 09 23 00 - GYPSUM PLASTER**

#### **3.7.2.1 PART 1 – GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Supply and application of gypsum plaster on concrete and masonry at interior locations indicated on drawings, Schedule of Finishes and as specified herein.

##### **1.2. RELATED REQUIREMENTS**

- A. Standards of the following as referenced:

1. Civil & Structural Specifications - Cast in Place Concrete.
2. Section 042000 - Unit Masonry Assemblies
3. Section 092216 – Non-Structural Metal Framing.
4. Section 099000 – Paints & Coatings

##### **1.3. REFERENCE STANDARDS**

- A. Standards of the following as referenced:



1. ASTM C 28/C 28M - Standard Specification for Gypsum Plasters.
  2. ASTM C 35 - Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster.
  3. ASTM C 206 - Standard Specification for Finishing Hydrated Lime.
  4. ASTM C 842 - Standard Specification for Application of Interior Gypsum Plaster.
  5. BS EN 459-1, Building lime. Definitions, specifications and conformity criteria.
  6. BS 1191-1, Specification for gypsum building plasters. Excluding premixed lightweight plasters.
  7. BS 1199 and 1200, Specification for building sands from natural sources.
  8. BS EN 1008, Mixing water for concrete. Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete
  9. BS 5492, Code of practice for internal plastering.
- 1.4. SUBMITTALS**
- A. See Section 013000- Administrative Requirements, for submittals procedures.
  - B. Affidavits. Submit affidavits, or test report certification from testing laboratories, that plastering materials specified by reference standards and supplied for project meet specified requirements, if requested. Base tests on factory run of materials taken within three months of delivery to project.
- 1.5. QUALITY ASSURANCE**
- A. Performance Requirements. Perform work of this section to meet requirements of BS 5492, except where more stringent requirements are specified in this section.
  - B. Alternative Systems.
    1. Gypsum plaster specified in this section together with furring and lathing specified in Section 092216 may substitute for gypsum board system specified in Section 092216 under conditions specified in Section 016000.
    2. Proprietary spray-on gypsum plaster system may be substituted for plaster system specified in this section if approved by Engineer upon submission of complete details of materials and methods of the spray-on system.
- 1.6. DELIVERY, STORAGE AND HANDLING**
- A. Handle and store plaster materials to protect them from moisture and contamination.
- 1.7. MOCK-UP**
- A. Provide a mock-up of plaster on metal lath and on concrete, each of minimum 10sq.m area, at locations directed by Engineer for approval of finish plaster.
  - B. Remove disapproved mock-ups.
  - C. Approved mock-ups may be incorporated in the works. Otherwise, remove mock-ups.
  - D. Subsequent plaster work shall match approved mock-ups in all details
- 1.8. FIELD CONDITIONS**
- A. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site and cause no damage to the products specified in this section or to the performance of these products in use.
  - B. Follow recommendations of the supplier of the products.



- C. Environmental conditions shall include, but shall not be limited to, ambient temperature; humidity, moisture in the air and on the products and surfaces with which they are in contact, moisture content and temperature of the products and materials with which they are in contact.

### **3.7.2.2 PART 2 - PRODUCTS**

#### **1.1. PLASTER MATERIALS**

- A. Provide only premixed gypsum plaster.
1. Provide premixed plaster to meet specified requirements of BS1191, Part 1, or ASTM C842.
  2. Incorporate only materials specified in either one or the other specified reference standard.
    - a. Lime. To meet specified requirements of BS EN 459-1, or ASTM C206, Type S where in contact with concrete and masonry, and Type N otherwise.
    - b. Sand. To meet specified requirements of BS 1199, or ASTM C35, and ASTM C842 for grading.
  3. Incorporate water to meet specified requirements of BS EN 1008 and Section 03300 for local requirements.
  4. Mix plasters materials to meet requirements of manufacturer's specifications. Do not mix any more material than can be used within one hour. Use mechanical mixers.
- B. Grout.
1. For metal door frames and metal trim, mix one part hardwall plaster to not more than 2- 1/2 parts sand by weight.
  2. Hangers, Main Runner Channels, Cross Furring Channels, Tie Wire, Furring Clips, Expanded Metal Lath/Gypsum Lath, Corner Reinforcing: refer to Section 09 2236.23 Furring and Lathing.

### **3.7.2.3 PART 3 - EXECUTION**

#### **1.1. EXAMINATION**

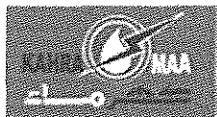
- A. Verify that existing conditions are satisfactory before starting work.
- B. Ensure that environmental conditions and installations preceding that of this section are satisfactory and will permit compliance with the quality and dimensions required for plastering systems specified in this section.

#### **1.2. PREPARATION**

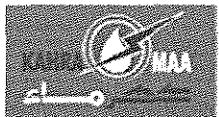
- A. Dampen masonry surfaces to reduce excessive suction.
- B. Clean concrete surfaces of foreign matter. Thoroughly dampen surfaces before using acid solutions, solvent, or detergents to perform cleaning. Wash surface with clean water.
- C. Roughen smooth concrete surfaces and smooth faced masonry.
- D. Apply bonding agent in accordance with manufacturer's instructions.

#### **1.3. PLASTERING**

- A. Apply gypsum plaster in accordance with ASTM C842 and manufacturer's instructions.
1. Plaster door, window, and other opening reveals.



2. Install intermediate plaster screeds where permanent grounds are too separated to ensure accurate application to specified thickness.
  3. Apply three coats of plaster on metal lath consisting of scratch coat, brown coat and the finishing coat. The scratch coat shall contain hair or fiber. Thickness of system measured from face of metal lath shall be minimum 13mm.
  4. Apply plaster on masonry in three coats in accordance with the manufacturer's instructions. The thickness shall not exceed 15 mm. Contractor may apply in two coats in accordance with accepted practice after submitting Method Statement and approval of the Engineer.
  5. Apply plaster on vertical concrete surfaces in three coats in accordance with manufacturer's instructions. The thickness shall not exceed 15 mm.
  6. Do not use mixes after they have initially set. Re-tempering will not be permitted.
  7. If necessary to correct inaccuracies, dub out in thickness of not more than 10 mm in same mix as first coat. Allow each coat to set before the next is applied. Cross scratch surface of each dubbing out coat immediately after set.
  8. Dubbing out will not be permitted on smooth dense concrete surfaces.
- B. Base Coats.
1. Work undercoat well into openings of metal lath to obtain maximum key.
  2. Apply each undercoat firmly to achieve good adhesion and in one continuous operation between angles and joints. Screed to an even surface and cross scratch each coat to provide a key for the next plaster coat.
  3. Ensure that moisture is controlled in base coats during 8 hour curing period.
- C. Finish Coats.
1. Apply finish plaster coats to surfaces that are partially of tile, glazed block or other finished masonry materials after the other materials are installed.
  2. Smooth plaster finish shall be trowelled or floated to produce a tight, matt smooth surface with no hollows, abrupt changes of level, trowel marks, or cracks. Do not use water brush and avoid excessive trowelling and over polishing.
  3. Cut 3mm wide x 3mm deep Vee joints in faces of plaster that meet metal trim or other dissimilar surfaces on the same plane.
  4. Make junctions between separate applications flush, and without change in texture, plane or colour.
  5. Ensure that finishes are free from blemishes, irregularities, lap streaks, brush marks, or similar defects
  6. Apply smooth, trowel finish, gypsum lime, putty coat where plaster finish is indicated on drawings or schedules, or both.
- 1.4. CLEANING AND PARCHING
- A. Remove plaster droppings from property, materials and surfaces of others before it sets.
  - B. Clean off beads, screeds and metal trim, and leave plaster and accessory surfaces ready for specified finishing.



- C. Cut out and patch defective plaster and cracks, prior to decorating, to match adjacent surfaces in texture and finish and with no visible joint lines.

#### 1.5. TOLERANCES

- A. Finish plasters flush with grounds, beads and casings.
- B. Ensure that finish surfaces are flat within 3mm under a 3 m straight edge.
- C. Ensure that surface planes are within 3mm of dimensioned location.

### **3.7.3 SECTION 09 24 00 - PORTLAND CEMENT PLASTER**

#### 3.7.3.1 PART 1 - GENERAL

##### 1.1. SECTION INCLUDES

- A. Supply and apply Portland cement plaster (rendering) at exterior locations indicated on drawings, and at interior locations as indicated on drawings, Schedule of Finishes and as specified herein.

##### 1.2. RELATED REQUIREMENTS

- A. Related Requirements:

1. Section 092216 – Non-Structural Metal Framing
2. Section 093000 - Tiling
3. Section 099000 - Painting and Coating

##### 1.3. REFERENCE STANDARDS

- A. Related Standards:

1. ASTM C 150 - Standard Specification for Portland cement.
2. ASTM C 206 - Standard Specification for Finishing Hydrated Lime.
3. ASTM C 897 - Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters.
4. ASTM C 926 - Standard Specification for Application of Portland Cement-Based Plaster; 2006.
5. BS EN 197-1, Cement. Composition, specifications and conformity criteria for common cements.
6. BS EN 459-1, Building lime. Definitions, specifications and conformity criteria.
7. BS 1199 and 1200, Specifications for building sands from natural sources.
8. BS EN 1008, Mixing water for concrete. Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete.
9. BS 5262, Code of practice for external renderings.
10. BS 5492, Code of practice for internal plastering.

##### 1.4. SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittals procedures.
- B. Affidavits. Submit affidavits, or test report certification from testing laboratories, that plastering materials specified by reference standards and supplied for project meet specified requirements, if requested. Base tests on factory run of materials intended for delivery to project.

##### 1.5. QUALITY ASSURANCE

- A. Perform Work in accordance with BS 5362.



**1.6. DELIVERY, STORAGE AND HANDLING**

- A. Handle and store plaster materials to protect them from moisture and contamination.

**1.7. MOCK-UP**

- A. Provide a mock-up of minimum 10 sq/m area on concrete unit masonry at location directed by Engineer for approval of finish plaster.

- B. Remove disapproved mock-ups.

- C. Approved mock-up may be incorporated in the works. Otherwise, remove mock-up.

- D. Subsequent plaster work shall match approved mock-up in all details.

**1.8. FIELD CONDITIONS**

- A. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site and cause no damage to the products specified in this section or to the performance of these products in use.

- B. Follow recommendations of the supplier of the products.

- C. Environmental conditions shall include, but shall not limited to, ambient temperature, humidity, moisture in the air and on the products and surfaces with which they are in contact, moisture content and temperature of the products and the materials with which they are in contact.

**3.7.3.2 PART 2 - PRODUCTS**

**1.1. PLASTER MATERIALS**

- A. Portland Cement, Aggregates, and Other Materials: In accordance with ASTM C 926.

- B. Portland Cement: Ordinary Portland cement to meet requirements specified in BS EN 197-1, or ASTM C150, Type 1.

- C. Aggregate for Cement Plaster: Grade sand for exterior base coat to conform to following sieve analysis:

Sieve size	% Passing Sieve
4.75mm	100
2.36mm	80 to 98
1.18mm	60 to 70
0.6mm	35 to 70
0.3mm	10 to 30
0.15mm	not more than 10

1. Otherwise, aggregate shall meet specified requirements of BS 1199 or ASTMC897.

- D. Lime. Hydrated to meet specified requirements of BS EN 459-1 or ASTM C206, Type S.

- E. Water. To meet specified requirements of BS EN 1008, and Section 03300 for local requirements.

- F. Ancillary material for blockwork and plaster such as galvanized angle / stop beads, metal laths, control joints, beads, strip mesh, dove and fishtail joints etc. to meet the requirements of the relevant British Standards.



## 1.2. PLASTER MIXES

- A. Base Coat. Mix by weight in proportions of one part portland cement to six parts sand with 1/4 part (by volume) plasticizer as approved by Engineer. When hand mixed, combine cement, and aggregate dry to uniform colour before adding water and thoroughly mixing to proper consistency. When machine mixed, first place water in mixer, then with mixer in operation add half aggregate, followed by cement, and then remainder of aggregate.
- B. Finish Coat. Mix by weight in proportions of one part portland cement to five parts of sand. Use white sand and cement for white finish plaster.
- C. Mix only as much plaster as can be used prior to initial set.
- D. Mix materials dry, to uniform colour and consistency, before adding water.
- E. Protect mixtures from contamination and excessive evaporation.
- F. Do not retemper mixes after initial set has occurred.

### 3.7.3.3 PART 3 - EXECUTION

#### 1.1. EXAMINATION

- A. Verify the suitability of existing conditions before starting work.

#### 2.1. PLASTERING

##### A. Application.

1. Remove all laitance, loose material, foreign bodies and coating from substrates. Scable smooth substrates to ensure good key.
2. Apply exterior plaster systems as recommended and specified in BS 5262 for rendered finishes.
3. Apply interior plaster systems as recommended and specified in BS 5492 for internal plastering.
4. Provide intermediate plaster screeds where permanent grounds are too separated to ensure accurate application to specified thickness.
5. Cement Plaster, Two Coat System.
  - a. Consists of a brown coat and a finish coat, both of portland cement plaster, applied over concrete or concrete unit masonry.
6. Cement Plaster, Three Coat System.
  - a. Consists of a scratch coat, a brown coat, and a finish coat, all of portland cement plaster, applied over metal lath, where designated.
7. Cement Plaster Base Coats
  - a. Apply full scratch coat with sufficient pressure to form key to lath. Cross scratch and allow to set.
  - b. Damp cure for not less than 48 hours.
  - c. Apply brown coat over dampened scratch coat, or to moistened concrete substrate, with sufficient pressure to form positive bond, to a total thickness of 15mm. Rod level, leave rough and allow to set. Splash concrete and masonry substrates with a slurry coat before plastering.
  - d. Damp cure for not less than 72 hours.



- e. Damp cure each coat with a light fog spray. Avoid excessive wetting and protect from excessive drying air.
  8. Cement Plaster Finish Coats.
    - a. Do not apply cement plaster finish coat for at least 7 days after preceding coat has been applied.
    - b. Before application of finish coat dampen base coat to achieve uniform suction.
    - c. Apply thin coat of cement plaster finish, allow to dry. Follow up with second coat, permit water to leave surface and when glaze has left, rough float and then finish float to a smooth surface. Provide a smooth finish.
  - B. Apply plaster in accordance with ASTM C 926.
- 1.2. CLEANING AND PATCHING
1. Remove plaster droppings from property, materials and surfaces of others before it sets.
  2. Clean off beads, screeds and metal trim and leave plaster and accessory surfaces ready for specified finishing.
  3. Cut out and patch defective or hollow plaster and cracks prior to decorating, to match adjacent surfaces in texture and finish and with no visible joint lines.
- 1.3. TOLERANCES
1. Finish plaster flush with grounds, beads, and casings.
  2. Ensure that finish surfaces are flat within 3mm under a 3.0m straight edge
  3. Ensure that surface planes are within 3.2mm of dimensioned location.

**END OF SECTION 09 24 00**

**3.7.4 SECTION 09 29 00 - GYPSUM BOARD ASSEMBLIES**

**3.7.4.1 PART 1 - GENERAL**

**1.1. SECTION INCLUDES**

- A. Supply and installation of gypsum board (plaster board) for dry wall system for interior partitions, wall facings, encasing to service pipes and ceiling as indicated on drawings and specified herein. This includes,
- B. Metal stud framing.
- C. Metal channel ceiling framing.
- D. Gypsum board.
- E. Joint treatment and accessories.

**1.2. RELATED REQUIREMENTS**

**A. Related Requirements:**

1. Civil & Structural Specifications - Cast-in-Place Concrete.
2. Section 042000 - Unit Masonry Assemblies
3. Section 072100 - Thermal Insulation
4. Section 079200 - Joint Sealers: Acoustic sealant.

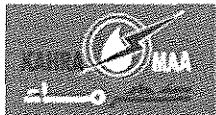


5. Section 099000 - Painting and coating
6. Acoustics Specifications – acoustic requirements

### 1.3. REFERENCE STANDARDS

#### A. Reference Standards:

1. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
2. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM C 36/C 36M - Standard Specification for Gypsum Wallboard.
4. ASTM C 473 - Standard Test Methods for Physical Testing of Gypsum Panel Products; 2007.
5. ASTM C 475/C 475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
6. ASTM C 514 - Standard Specification for Nails for the Application of Gypsum Board; 2004.
7. ASTM C 630/C 630M - Standard Specification for Water-Resistant Gypsum Backing Board.
8. ASTM C 645 - Standard Specification for Nonstructural Steel Framing Members; 2007.
9. ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2007.
10. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board.
11. ASTM C 1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
12. ASTM C 1396/C 1396M - Standard Specification for Gypsum Board; 2006a.
13. ASTM D 1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
14. ASTM D 3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2000 (Reapproved 2005).
15. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2004.
16. ASTM E 413 - Classification for Rating Sound Insulation; 2004.
17. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2007.
18. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2006.
19. BS 476-10, Fire tests on building materials and structures. Guide to the principles & application of fire testing.
20. BS 476-20, Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles).
21. BS 476-21, Fire tests on building materials and structures. Methods for determination of fire resistance of loadbearing elements of construction.
22. BS 476-22, Fire tests on building materials and structures. Methods for determination of fire resistance of non-loadbearing elements of construction.
23. BS 476-23, Fire tests on building materials and structures. Methods for determination of the contribution of components to the fire resistance of a structure.



24. BS 1494-1, Specification for fixing accessories for building purposes. Fixings for sheet, roof and wall coverings.
25. BS 6452, Beads for internal plastering and dry lining. Specification for galvanized steel beads.
26. BS 8212, Code of practice for dry lining and partitioning using gypsum plasterboard.
27. BS EN 10143, Continuously hot-dip metal steel sheet coated and strip on dimensions and shape tolerances.
28. BS EN 10162, Cold rolled steel sections. Technical delivery conditions. Dimensional and cross-sectional tolerances.
29. BS EN 10244-2, Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Zinc or zinc alloy coatings.
30. BS 4174, Specification for self-tapping screws and metallic drive screws.

#### **1.4. SUBMITTALS**

- A. See Section 013000- Administrative Requirements, for submittal procedures.
- B. Shop Drawings. Submit shop drawings of framing system installation details and brochures and of access doors, illustrating materials intended for installation
  1. Include hanger insert layout with insert type and weight supported indicated for each insert.
  2. Locate ceiling access doors on shop drawings after coordination with MEP specifications. Any additional ceiling access doors requested by the Engineer to properly access services above the ceiling shall be provided at no extra cost.
- C. Samples. Submit to site samples of gypsum board, framing members, inserts, accessories and fasteners
- D. System Data. Submit structural design data to verify that framing systems, anchorage and fasteners meet requirements for each system.

#### **1.5. QUALITY ASSURANCE**

- A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.
- B. Install fire rated gypsum board systems to meet requirements of local Civil Defense Authority.
  1. Fire rated gypsum board and metal stud framing shall conform to BS 8212, complete with gypsum board trim accessories conforming to BS 6452
- C. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 3 years of documented experience.
- D. Alternative System. Gypsum plaster on furring and metal lath as specified in Sections 092216 will be an acceptable alternative system under conditions specified in Section 016000 to gypsum board system specified in this section

#### **1.6. MOCK-UP**

- A. Provide a minimum 10sq.m. mock-up of each type of finished gypsum board wall installation and one ceiling installation, including casing bead and access panel at locations directed by Engineer for approval of installation.
- B. Remove disapproved mock-ups.
- C. Approved mock-up may be incorporated in the works. Otherwise, remove mock-up.
- D. Subsequent gypsum board installations shall match approved mock-up in all details.

#### **1.7. ENVIRONMENTAL REQUIREMENTS**



- A. Install interior gypsum board systems only in areas protected against weather. However the Contractor to guarantee the final product will not be damaged due to thermal movements by environmental conditions. Damaged material, if any, will be replaced at no extra cost to the Client.
  - B. In cold weather ensure that heat is introduced in sufficient time, before installation commences, to bring surrounding materials up to these temperatures and that it is maintained until materials installed by this section have cured.
  - C. Do not install gypsum board systems in any area unless satisfied that construction in place has dried out and that no further installation of damp materials is contemplated.
  - D. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site and cause no damage to the products specified in the section or to the performance of these products in use.
  - E. Follow recommendations of the supplier of the products.
  - F. Environmental conditions shall include, but shall not be limited to, ambient temperature; humidity; moisture in the air and on the products and surfaces with which they are in contact; moisture content and temperature of the products and materials with which they are in contact.
- 1.8. **DELIVERY, HANDLING AND STORAGE**
- A. Package finish materials.
  - B. Store materials in protected dry areas. Store board flat in piles with edges protected.
  - C. Ensure that finish metal members are not bent, dented, or otherwise deformed.
  - D. Deliver products supplied only by this section to those who are responsible for installation, to the place they direct and to meet installation schedules.

#### 3.7.4.2 PART 2 - PRODUCTS

##### 1.1. GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C 840 and GA-216.

##### 1.2. METAL FRAMING MATERIALS

- A. Furring and Framing System.
  - 1. Furring Channels. 0.55mm thick cold rolled steel, wiped coated, nominal size of 13 or 19mm deep as required by detail and span, hat type with knurled face.
  - 2. Resilient Furring Channels. USG Type RC-1 Resilient Channel or equivalent as approved.
  - 3. Steel Studs. 0.55mm thick steel, wiped coated, having knurled flanges 32mm wide minimum and with edges doubled back at least 4.8mm, with girts as required and with service access holes.
- B. Ceiling Hangers.
  - 1. Hanger Anchor Inserts. Install expansion bolt sleeves in drilled holes for threaded eyes or hanger rods of size and type to support total load of ceiling and other components supported by ceiling.
  - 2. Hangers. Zinc coated annealed steel rod.
    - a. 2.8mm dia. to support a maximum weight of 68 kg per hanger.
    - b. 3.8mm dia. to support a maximum weight of 140 kg per hanger
    - c. 4.8mm dia. to support a maximum weight of 250 kg per hanger.



- C. Galvanizing. To meet specified requirements of BS EN 10143, zinc coating designation G 275, or ASTM Specification A 653/A 653M, Zinc coating designation Z275, for sheet steel; ASTM Specification A 153, Class B.3, Coating for hardware and bolts; BS EN 10244-2 or A116, Class 3, coating for wire and rods.
- D. Corner Beads, Casing Beads and Control Joints.
  - 1. Fabricate of formed galvanized steel. Minimum 0.64mm galvanized and as approved by Engineer.
  - 2. Provide standard beads and joints at boards with square ends.
  - 3. Provide specially fabricated beads at board ends cut at obtuse and acute angles as indicated on drawings.
  - 4. Manufacturer. As approved and supplied by gypsum board manufacturer and approved by Engineer.
- E. Shadow Mould Reveals.
  - 1. Extruded aluminium, mill finish, of profile indicated on drawings, at intersection of walls and ceilings.

### 1.3. BOARD MATERIALS

- A. Provide Gypsum Board System incorporating materials and accessories in their entirety from one of the manufacturers approved by the Engineer.
  - 1. or approved equal
  - 2. Substitutions: See Section 01600 - Product Requirements.
- B. Wallboard: Paper-faced gypsum wallboard as defined in ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  - 2. Thickness:
    - a. Vertical Surfaces: 13 mm.
- C. Gypsum Wallboard: ASTM C 1396/C 1396M. Sizes to minimize joints in place; ends square cut.
  - 1. Regular Type:
    - a. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
    - b. Thickness: As indicated.
  - 2. Edges: Tapered.
- D. Fire Resistant Type: Complying with Type X requirements; UL or WH rated.
  - 1. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
  - 2. Application: Where required for fire-rated assemblies, unless otherwise indicated.
    - a. Thickness: As indicated.
  - 3. Edges: Tapered.
  - 4. Application. Exterior walls and ceilings below unheated spaces. unless otherwise indicated.
- E. Abuse-Resistant Type: Gypsum wallboard especially formulated for increased impact resistance, with enhanced gypsum core and heavy duty face and back paper.
  - 1. Thickness: As indicated.
- F. Moisture and Mold Resistant Type Board: Non-combustible moisture and mold-resistant gypsum core.
  - 1. Comply with ASTM C 1396/C 1396M.



2. Moisture absorption: < 5% tested as per ASTM C 473.
  3. Resistance to mold growth: Score 10 when tested as per ASTM D 3273.
  2. Thickness: As indicated.
- G. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M; ends square cut.
1. Thickness: As indicated.
  2. Edges: Tapered.
- H. Backing Board: Fire rated as approved by the Engineer.
1. Edges. Square
  2. Thickness: As indicated.
- 1.4. ACCESSORIES**
- A. Acoustic Insulation.
1. Rockwool Lapinus, or
  2. Noise Barrier Batt Insulation by Owens-Corning Fiberglass Corp., or
  3. Thermafiber Sound Attenuation Batts by United States Gypsum Company, or
  4. Equivalent as approved.
- B. Acoustic Sealant. Non-hardening, non-skimming, for use in conjunction with gypsum board.
1. Tremco Acoustical Sealant by Tremco, or
  2. equivalent by Expandite or PCI Polychemie GMBH or equivalent approved.
- C. Screws. For securing gypsum board to metal furring Self-drilling, self-tapping, case-hardened, Phillips head, drywall screws, with corrosion resistant finish to meet requirements of BS 1494 or BS 4174, as applicable, or ASTM Specification C 1002.
1. # 6 x 25mm for single thickness board fastening,
  2. # 7 x 41mm for double thickness board fastening.
  3. Increase fasteners by 12mm in length at wood framing.
- D. Tie Wire. 1.6mm dia. galvanized soft, annealed, steel, wire.
- E. Neoprene Gasket. 6mm thick, closed cell neoprene, full width of stud, black, to meet specified requirements of ASTM D1056, SCE-4, with pressure sensitive adhesive on one face, maximum water absorption by weight of 5%, average density of 130 to 190 kg/cu.m., maximum compression set of 25% and resistance to flex without cracking to 80 deg.
- F. Board Masonry Adhesive. As approved and supplied by gypsum board supplier.

#### **3.7.4.3 PART 3 - EXECUTION**

##### **1.1. EXAMINATION**

- A. Before application of board systems commences, ensure that services have been installed, tested and approved, that conduits, pipes, cables and outlets are plugged, capped, or covered and that fastenings and supports installed by other sections are in place.
- B. Ensure that environmental conditions and construction completed before installation of gypsum board systems commences are satisfactory and will permit compliance with the quality and dimensions



required for gypsum board installation specified in this section. Do not permit installations of others to touch the back of gypsum board.

- C. Verify that Zee-bars installed for rigid insulation are located properly and are well secured.

## 1.2. FRAMING INSTALLATION

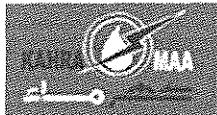
### A. General.

1. Coordinate installation of systems specified in this section with installations of other sections for:
  - a. Attachment of hangers, fasteners, stiffeners and reinforcing.
  - b. Support and incorporation of flush-mounted and recessed components. Ensure adequacy of supports by consultation and verification of methods as specified.
2. Install systems in accordance with approved manufacturers' specifications and printed directions, as applicable for materials incorporated.
3. Do not install metal framing, trim, casings, or accessories which have been bent, dented, or otherwise deformed.
4. Securely attach trim, casings, framing and accessories.
5. Framing and furring shown on drawings is indicative but do not regard it as exact or complete. Construct systems to provide adequate strength to withstand stresses imposed by use without distortion and to maintain dimensions indicated on drawings.
6. Provide continuous backing for all edges of board. To ensure continuous backing, install additional furring where Zee-bar backing at insulation is insufficient.
7. Erect supporting and finish materials to dimensions indicated on drawings, plumb, level, straight and square to adjoining elements.
8. Provide for movement at intersections with structural members to avoid transference of loads to systems.
9. Make allowances for thermal movements in systems.
10. Do not support systems from, nor make attachment to, ducts, pipes, conduit, or the support framing installed by other sections.
11. Install materials with the minimum of joints.
12. Splice framing members only where continuous lengths are not available from manufacturer.
13. Frame openings on every side with suitable sections. Provide clearances required at mechanical and electrical services such as grilles, diffusers, access panels and lighting fixtures only after verification of requirements in each case.
14. Cooperate with other sections. Where the installations of other sections penetrate board construction, fit openings snugly and to ensure cover by escutcheons and plates utilized.
15. Attach to framing adequate steel reinforcing members to support the load of and to withstand the withdrawal and shear forces imposed by, items installed by other sections upon systems. Such items are, but are not restricted to, coat hooks, washroom accessories, handrail anchors, guards, wall-hung cabinets and fitments, shelving, curtain and drapery tracks and minor mechanical and electrical equipment and fixtures. Heavy mechanical and electrical equipment shall be self-



supporting as specified in other Divisions. Light fixtures as designated on drawings to be hung and aligned by special vertical and/or horizontal rods independent of ceiling support hangers.

16. Provide bulkheads over doors, frames, screens and changes in ceiling levels, all as indicated on drawings.
- B. Suspended Ceiling and Bulkhead Framing and Furring.
  1. Install expansion bolt sleeves in drilled holes to provide anchors for ceiling hangers.
  2. Secure threaded hangers or eyebolts to anchors, locked in place to prevent loosening by vibration. Where eyebolts are used, tie hangers securely to eyebolts.
  3. Space hangers for runner channels to suit structure, to support ceiling load, at a maximum distance of 1200mm on centre and at no greater distance than 150mm from ends of runner channels.
  4. Except where indicated otherwise on drawings or required by conditions, install runner channels at 900mm on centre and at no greater distance than 150mm from terminations of supported cross furring members. Bend rod hangers sharply under bottom flange of runners and wire securely in place with saddle ties.
  5. Splice runner channels by lapping at least 300mm, with interlocking flanges and wired at each end with two loops. Do not bunch or line up splices.
  6. Except where indicated otherwise on drawings or required by conditions, install cross furring at 400mm on centre, generally and 30mm on centre for water resistant gypsum board and at no greater distance than 150mm from walls, openings, breaks in continuity of ceiling and changes of direction. Space furring in all cases to suit incorporated services and so as to avoid contact with perimeter walls. Span hat-type furring no greater than 1200mm. Use metal studs for greater spans, 42mm deep spanning to 1525mm, 63mm deep to 1800mm and 92mm deep to 2400mm.
  7. Secure cross furring to supports with double wire ties or approved equivalent attachment. Splice by nesting and tying together with 200mm overlap.
  8. Erect entire hanger and suspension system to adequately support the ceiling assembly, including services incorporated, with a maximum specified deflection for each component member and free from horizontal movement.
  9. Install resilient furring channels as indicated at sound rated systems in accordance with channel manufacturer's recommendations to maintain resiliency.
  10. Install access panels, secured in place as recommended by panel manufacturer.
- C. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
- D. Studs: Space studs as permitted by standard.
  1. Extend partition framing to structure where indicated and to ceiling in other locations.
  2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- E. Sound Rated Partitions
  1. At partitions indicated as providing low sound transmission, set runners at top and bottom in three continuous beads of acoustical sealant, additionally, seal joints between gypsum board and abutting soffit and floor surfaces with acoustic sealant.



2. Fill voids between studs with insulation as indicated on drawings. Ensure that insulation is supported permanently by lugs, wires or other mechanical means against sagging and that a continuous blanket is installed with no gaps between batts or between batts and framing.
  3. Extend all layers on gypsum board to underside of structure overhead unless otherwise shown.
- F. Furring at Masonry Walls.
1. Except where indicated otherwise on drawings or required by conditions, install furring horizontally at 400mm on centre. Space furring no greater than 50mm from abutting walls, floors, ceilings and openings or otherwise indicated on drawings.
  2. Secure furring to walls with fasteners, such as hardened nails, spaced at 600mm on centre alternating on opposite channel flanges. Shim to plumb and level with metal spacers, or use adjustable wall furring brackets.
  3. Return furring into reveals.
  4. Close all exposed open ends of furred spaces with suitable metal closures.
  5. Where wall furring is indicated clear of wall on drawings, construct framing as for metal stud partitions. Secure horizontal bracing channels to studs located at 1200mm on centre. Secure bracing channels to wall with bracing channel members bent to suit, fastened to both bracing channel at studs and to wall and spaced at 1800mm on centre
- 1.3. ACOUSTIC ACCESSORIES INSTALLATION
- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
  - B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
    - a. At partitions indicated as providing low sound transmission, set runners at top and bottom in three continuous beads of acoustical sealant. Additionally, seal joints between gypsum board and abutting soffit and floor surfaces with acoustic sealant.
    - b. Fill voids between studs with insulation as indicated on drawings. Ensure that insulation is supported permanently by lugs, wires or other mechanical means against sagging and that a continuous blanket is installed with no gaps between batts or between batts and framing.
  - C. Extend all layers on gypsum board to underside of structure overhead unless otherwise shown.
- 2.1. BOARD INSTALLATION
- A. Comply with ASTM C 840 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
  - B. Application of Gypsum Board to Framing.
    1. Extend board into door, window and other opening reveals, behind mirrors, fitments and other applied items of a fixed nature and on metal stud partitions to structure above, unless noted otherwise on drawings.
    2. Apply board with long dimensions perpendicular to supports except at stud partitions where they shall parallel studs.
    3. Back all joints with a framing member. Locate joints on opposite sides of partitions on different studs and at least 300mm from opening jambs.



- a. Install board in maximum lengths and widths to minimize joints and in lengths of 1800mm minimum and stagger end joints where they are unavoidable. Locate joints in ceilings where least prominently discerned and never line them up with opening edges.
  - b. Tightly butt gypsum board joints, without force and align them neatly.
  1. Form neat joints at mill ends and at edges of board panels cut in field. Cut paper on face with a knife. Smooth by sanding and rubbing edges together.
  2. Do not install gypsum board in close proximity to hot pipes or heating ducts.
  3. Fasten gypsum board to metal support members by metal drywall screws. Secure board along full length of each framing member.
  4. Double layer installations shall consist of a basic layer of board secured to framing and a second layer of board secured to framing over the basic layer.
  5. Locate fasteners at 10mm minimum to and 13mm maximum from, center of joints. Space fasteners for basic layer of board at 750mm on centre at edges and in field. Space fasteners for single layer board and second layer board at 200mm on centre at edges and at 300 mm on centre in field, unless required otherwise by test design specification that validates required fire rating.
  6. Start application on walls at corners of rooms and on ceilings from center line of spaces. Do not force adjacent boards into place, allow moderate contact. Install extension clips where required. Drive screws to form a slight depression, but not so paper cover is broken.
  7. Install board with casing bead at termination of gypsum board edge abutting adjoining surfaces to provide for differential movement at internal corners.
- C. Adhesive Application of Gypsum Board to Masonry.
1. Cut gypsum board to allow continuous 3mm to 6mm clearance at floor.
  2. Apply board masonry adhesive to back of board in accordance with adhesive manufacturer's directions.
  3. Position panels vertically over surfaces and press into place to develop full adhesive contact.
  4. Temporarily secure gypsum board with concrete nails or bracing to ensure adequate bond until adhesive cures.
- D. Fire-Rated Construction. Install gypsum board in strict compliance with requirements of listing authority.
1. Construct gypsum board fire separation assemblies provided for ducts penetrating fire rated partitions and consisting of metal framing covered on both sides by fire-rated gypsum board.
  2. Fit assemblies tightly to enclosing constructions to maintain integrity of the separations.
  3. Install casing beads at all perimeter edges. Fire tape as necessary.
  4. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead unless shown otherwise.
- E. Cementitious Backing Board: At all wet wall locations, in accordance with ANSI A108.11 and manufacturer's instructions.
- 1.3. INSTALLATION OF TRIM AND ACCESSORIES
- A. At External Corners. Install corner beads secured to framing at 150mm on centre on alternate flanges.



- B. At Board Edges. Secure casing beads at 300mm on centre at edges exposed to view, where board butts against other materials with no trim to conceal junction, at control joints, at perimeter of ceiling surfaces, at tops of partitions where they stop against continuous ceiling surfaces and where otherwise indicated on drawings.
- C. Incorporate expansion joints as indicated on drawings.
- D. Install control joints in interior gypsum board systems at no greater spacing than 9m for walls and 15m for ceilings in each direction, at perimeters of ceilings where they abut walls and other vertical surfaces, or as otherwise indicated. Line up control joints with joints in other construction or with centre lines of mullions, columns, piers, or similar building elements.
- E. Install casings and thermal breaks at junctions of gypsum board with exterior door, window, or screen frames.

#### 1.4. JOINT TREATMENT

- A. Fill joints, casing beads, corner beads, holes at board fasteners and depressions on board surfaces exposed to view to ensure smooth seamless surfaces and square neat corners. Use jointing compounds and reinforcing tapes in conformance with manufacturer's specifications. Ensure that board is tight against framing members, fasteners are properly depressed and adhesives have sufficiently cured.
- B. Fill joints by three-coat method;
  1. Embed reinforcing tape in a cover coat of joint filler.
  2. Apply level coat of joint filler when cover coat has dried.
  3. Apply skim coat of topping cement when level coat has dried.
  4. Feather edges of compounds into surfaces of boards. After skim coat has dried for at least 24 hours sand to leave smooth for decoration. Do not sand paper face of board.
- C. At Bevelled Joints. Apply cover coat 180mm wide, level coat 250mm wide and skim coat 300mm wide.
- D. At End Joints and Butt Joints, formed at cut edges of board, apply cover coat 355mm wide, level coat 500mm wide and skim coat 600mm wide. Camber treatment over end joints to 0.8mm thick at most.
- E. At Internal Corners. First fill gaps between boards with joint filler. Embed creased reinforcing tape in a thin coat of joint filler applied 50mm wide at each side of corner. Apply cover coat as specified for bevelled joints. Apply skim coat (as specified for beveled joints) to just one side of joint and when dry, apply skim coat to other side.
- F. At External Corners. Fill to nose of corner bead with joint filler and topping cement as specified for bevelled joints.
- G. At Casing Beads and Access Panel Flanges. As specified for bevelled joints.
- H. At Board Fasteners. Fill holes and depressions with a two coat application of joint filler.
- I. Caulking;
  1. Caulk between casing beads and other construction where junctions are exposed to view.
  2. Clean joints and prime and install sealants in accordance with the requirements of Joint Sealants, Section 07 9200.
- J. Finish gypsum board in accordance with levels defined in ASTM C 840, as follows:
  1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.



2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- K. Finish all gypsum board in accordance with ASTM C 840 Level 4.
- L. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

#### **1.5. TOLERANCES**

- A. Install board within 3mm of dimensioned location unless approved otherwise and flat to a tolerance of 1mm maximum in 1000 mm.
- B. Install framing members to ensure that deflection of each member does not exceed 1/360 of its span under dead load and loads imposed by mechanical and electrical equipment and fixtures supported by the ceiling

#### **1.6. ADJUSTMENT AND CLEANING**

- A. Remove droppings and excess of joint compound from property, materials and surfaces of others and from board and accessories installed by this section, before it sets.
- B. Make good to cut-outs for services and other installations, fill in defective joints, holes and other depressions with joint compound.
- C. Make good defective board installations and ensure that surfaces are smooth, evenly textured and within specified tolerances to receive finish treatments.
- D. Clean off beads, casings, other metal trim and leave all surfaces ready for specified finishes.

### **3.7.5 SECTION 09 30 00 - TILING**

#### **3.7.5.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Supply and installation of floor and wall tile on concrete, masonry and moisture resistant wall board as indicated on drawings, Schedule of Finishes and as specified herein.
- B. Supply and installation of plaster on metal lath where required for installation of tile backing at recessed accessories.
- C. Caulking where indicated and specified at tile and marble.
- D. Performance of aforementioned tile and caulking work as indicated on drawings, at locations indicated on

##### **1.2. RELATED REQUIREMENTS**

###### **A. Related Requirements:**

1. Civil & Structural Specifications - Cast in Place Concrete.
2. Section 042000 - Unit Masonry Assemblies.
3. Section 079200 - Joint Sealers.
4. Section 092400 - Portland cement Plaster.

##### **1.3. REFERENCE STANDARDS**



A. Reference Standards:

1. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium).
  - a. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland cement Mortar; 2005.
  - b. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar; 1999 (R2005).
2. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex Portland Cement Mortar; 1999 (R2005).
3. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 1999 (R2005).
4. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland cement Mortar or Latex-Portland Cement Mortar; 1999 (R2005).
5. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (R2005).
6. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (R2005).
7. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (R2005).
8. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (R2005).
9. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2008.
10. ASTM C 503 - Standard Specification for Marble Dimension Stone (Exterior)
11. TCA (HB) - Handbook for Ceramic Tile Installation; Tile Council of North America, Inc.
12. BS EN 197-1, Cement. Composition, specifications and conformity criteria for common cements.
13. BS EN 459-1, Building lime. Definitions, specifications and conformity criteria.
14. BS 1199 and 1200, Specification for building sands from natural sources.
15. BS EN 1008, Mixing water for concrete. Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete.
16. BS 5385-1, Wall and floor tiling. Code of practice for the design and installation of internal ceramic and natural stone wall tiling and mosaics in normal conditions.
17. BS 5385-2, Wall and floor tiling. Code of practice for the design and installation of external ceramic wall tiling and mosaics (including terra cotta and faience tiles).
18. BS 5385-3, Wall and floor tiling. Code of practice for the design and installation of ceramic floor tiles and mosaics.
19. BS 5385-5, Wall and floor tiling. Code of practice for the design and installation of terrazzo tile and slab, natural stone and composition block floorings.



20. BS 6431, Ceramic Floor and Wall Tiles. Parts 1 to 22 inclusive, as applicable

**1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, colour arrangement, perimeter conditions, and junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples. Submit 300mm X 300mm panels, or at least 9 units, of tile and of marble, selected at random from stock and coloured grout. Submit samples to site and to Engineer's Office.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods and polishes and waxes.

**1.5. QUALITY ASSURANCE**

- A. Qualifications. Perform tile installation specified in this section only by a firm who has adequate plant, equipment and skilled tradesmen to perform it expeditiously and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past five years.

**1.6. MOCK-UP**

- A. See Section 014000 - Quality Requirements, for general requirements for mock-up.
- B. Construct tile mock-up where indicated by Engineer, incorporating all components specified for the location.

**1.7. PRE-INSTALLATION MEETING**

- A. Convene one week before starting work of this section.

**1.8. DELIVERY, STORAGE, AND HANDLING**

- A. Protect adhesives from overheating in accordance with manufacturer's instructions.

**1.9. FIELD CONDITIONS**

- A. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site and cause no damage to the products specified in this section or to the performance of these products in use.
- B. Follow recommendations of the supplier of the products.
- C. Environmental conditions shall include, but shall not be limited to, ambient temperature, humidity, moisture in the air and on the products and surfaces with which they are in contact, moisture content and temperature of the products and materials with which they are in contact.

**1.10. EXTRA MATERIALS**

- A. Provide 2% of each size, colour and surface finish of tile specified.
- B. Provide marble in slab sizes sufficient to replace full vanity counter. Deliver extra stock in sealed labelled packages to Kahramaa as he directs at completion of maintenance period.

**3.7.5.2 PART 2 - PRODUCTS**

**1.1. MATERIALS - TILE**

- A. Ceramic/Porcelain Tile, General.



1. Only tile of colour, finish, and of quality and performance characteristics of specified tile as determined by applicable parts of BS 6431, will be considered as equivalent to the specified tile.
  2. Tile equivalent to specified tile may be approved by Engineer.
- B. Ceramic/Porcelain Wall Tile.
1. Refer to Schedule of Finishes for finishes and locations for tile types.
  2. Manufacturer: RAK Ceramics or equivalent approved.
- C. Ceramic/Porcelain Floor Tile.
1. Refer to Schedule of Finishes for finishes and locations for tile types.
  2. Manufacturer: RAK Ceramics or equivalent approved.
- D. Ceramic/Porcelain Mosaic Tile: ANSI A137.1, and as follows:
1. Refer to Schedule of Finishes for finishes and locations for tile types.
  2. Manufacturer: RAK Ceramics or equivalent approved.
  3. Moisture Absorption: 0 to 0.5%.
  4. Size and Shape: Refer Product Schedule.
- 1.2. TRIM AND ACCESSORIES
- A. Metal Edge Trim. Bevelled extruded aluminium to suit depth of tile setting, with mill finish, for use only at openings where edges of floor tile are exposed.
  - B. Unless otherwise indicated on drawings exposed edge of tiles will be full cushioned ceramic edge obtained in factory production.
  - C. Marble for thresholds. Refer to Schedule of Finishes and Drawings
  - D. Metallic Zinc strip threshold: 2mm. thick.
- 1.3. MORTAR MATERIALS
- A. Portland Cement. To meet specified requirements of BS EN 197-1.
  - B. Latex Additive. Laticrete 3701 as manufactured by Laticrete International Inc. or Plastigum 56P By Mapei Canada Inc., or BCR Bonding Compound by Building Chemical Research Company.
  - C. Sand. To meet specified requirements of BS 1199/1200, passing 1.6mm sieve. Use white sand for white grout.
  - D. Water. Potable, containing no contaminants which cause efflorescence, to meet specified requirements of BS EN 1008.
  - E. Thin (Dry) Set Mortar. Bond coat to meet specified requirements of ANSI Standard A118.1; Laticrete 4237 as manufactured by Laticrete International Inc., or Kerabond by Mapei Canada Inc., or PCI-Non-Sag by Polychemie GmbH, Feb, Cormix.
  - F. Mortar Bed Materials: 1part Portland cement, 4 parts sand, 1/10 latex additive minimum and 1 part water. (Includes latex additive)
- 1.4. GROUT MATERIALS
- A. Dry Curing Grout for dry areas: Premixed, dry set, as recommended by tile supplier and to meet specified requirements of ANSI A118.1;



- B. Dry Set Bond Coat and Grout for dry areas: Mix to manufacturer's instructions.
- C. Setting adhesive for wet areas:
- D. Setting and Grouting Epoxy for wet areas: To meet specified requirements of ANSI Specification A118.3,
- E. Epoxy Bond Coat and Grout for wet areas: Mix to manufacturer's instructions to achieve water resistant finish.
- F. Primer. To meet specified requirements of supplier of bond coat.

#### **1.5. ACCESSORY MATERIALS**

- A. Sealant. One part sanitary type silicone to meet specified requirements of Section 079200
- B. Sealer. High quality synthetic resin type for sealing unglazed tile, as recommended by tile manufacturer.
- C. Cleaner. As recommended by tile manufacturer.
- D. Waterproofing Membrane.
  - 1. Laticrete 9235 by Laticrete International Inc, or
  - 2. Thoroseal FX100 by BASF Construction Chemicals UAE LLC, or
  - 3. Planicrete W by Mapei Canada Inc., or
  - 4. Equivalent as approved.

#### **3.7.5.3 PART 3 - EXECUTION**

##### **1.1. EXAMINATION**

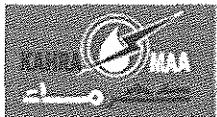
- A. Ensure that environmental conditions and backing surfaces have been provided according to specified requirements.
- B. Defective tile installation resulting from application to unsatisfactory surfaces will be considered the responsibility of this section.

##### **1.2. PREPARATION**

- A. Where no substrate is provided for tile as at back of recessed washroom accessories, provide cement plaster on metal lath to meet specified requirements of Sections 092216, 092300 and 092400.
- B. Secure metal edge trim by screw anchors and epoxy adhesive at exposed edges of tile in door openings.
- C. Install access doors as recommended by manufacturer.
- D. Protect surrounding work from damage.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.
- F. Sealing. Apply sealer to floor tile and/or thresholds as indicated in drawings in number of coats and by methods recommended by manufacturer to ensure that floor is properly sealed for intended use.

##### **1.3. WATERPROOF MEMBRANE**

- A. Apply waterproof membrane to substrate at Washroom and Kitchen/Pantry Floors as per Section specified in Division 07 "Thermal and Moisture Protection" or as manufacturer recommendation but subject for approval of Engineer on site.
- B. Clean down concrete to remove loose material, grease, oil and other foreign materials.



- C. Spread waterproofing compound to cover all floor areas and turn up a minimum of 100mm on vertical surface.

**1.4. INSTALLATION - GENERAL**

- A. Install tile and grout in accordance with applicable requirements of BS 5385 and ANSI A108.1 through A108.13, manufacturer's instructions and TCA Handbook recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings and lay so that fields are centred on areas, with no tiles of less than half size included. Maintain heights of panels in full courses to nearest indicated dimension.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners neatly. Align floor and wall joints.
- D. Lay tile on vertical surfaces with joints plumb and level.
- E. Leave or cut openings to correct sizes to receive accessories, fittings, or other items built into tile.
- F. Cut and grind tile accurately and without damage, to fit openings, at intersections and against trim finish. Rub exposed cut edges smooth with abrasive stone.
- G. Drill tile for hardware and for pipes. Cut and fit tile closely so that escutcheons cover cuts.
- H. Extend tile into recesses at windows, doors, or other openings.
- I. Extend wall tile behind fitments, mirrors and other applied items of a fixed nature, by a sufficient amount to ensure overlap.
- J. Provide joints 1.6mm wide between ceramic tile units.
- K. Provide joints of colour to match tile and marble.

**1.5. INSTALLATION - FLOORS - THIN-SET METHODS**

- A. Directly on structural slab, or screed substrate as applicable, with thin set bond coat and thin set system grout, for all areas except where acid resistant system is specified.

**1.6. INSTALLATION - WALL TILE**

- A. Directly on masonry, plaster or concrete substrate, as applicable, with slight leveling coat, thin set bond coat and dry curing wall grout
- B. Over gypsum wallboard on wood or metal studs install in accordance with TCA Handbook Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.
- C. Provide mortar bed in access panels.
- D. Exposed edges of tiles will be in all instances be the factory applied ceramic edge of tile unless otherwise indicated on drawings or approved by Engineer on site.

**1.7. SETTING**

- A. Place as much tile as possible in one operation before setting bed reaches initial set. Clean back and remove bed when it has set before tile is laid.
- B. Prime entire backing surface for bond coats.
- C. Prepare substrates and apply bond coats in accordance with grout manufacturer's directions to ensure complete and permanent bonding of tile.



#### **1.8. GROUTING**

- A. Colour. To match tile as approved.
- B. Remove spacers, strings, ropes or pegs before grouting.
- C. Grout tile joints in accordance with grout manufacturer's directions and to fill joints solidly.
- D. Finish grout to depth of the cushion on cushion edge tile.
- E. Fill all joints of square edge tile flush with surface of tile.
- F. Fill all gaps and skips and cover setting bed completely. Ensure that finish grout is uniform in colour, smooth and without voids, pinholes or low spots.
- G. Damp cure cement grout for at least 72 hours.
- H. Use epoxy grouts for wet areas.

#### **1.9. CAULKING**

- A. Caulk joints between tile and plumbing fixtures at floors and vanity counters with silicone sealant to meet specified requirements of Section 079200 of the specifications.

#### **1.10. INSTALLATION OF MARBLE THRESHOLDS**

- A. Install marble for full length of threshold of width to match the width of the door frame and 20mm thick with chamfer as indicated on drawings.
- B. Marble threshold shall not be more than 12 mm. above the finished floor to be barrier free.
- C. Install marble with epoxy bond coat.
- D. Seal joints between adjacent surface and marble with sealant to meet specified requirements of Section 079200.

#### **1.11. ADJUSTMENT AND CLEANING**

- A. Before Project completion, remove and replace defective, damaged, loose and unbounded tile and marble; and point defective joints.
- B. Clean tile, grout and marble surfaces with water.

### **3.7.6 SECTION 09 30 33 - CUT NATURAL STONE TILE**

#### **3.7.6.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Interior Marble/Granite wall facing of concrete structure and unit concrete masonry walls in areas noted on drawings.
- B. Interior Marble/Granite flooring and steps in areas drawings.
- C. Mortar filled joints at copings, exterior steps, planter facing, exterior pavers, interior flooring and counter facing.
- D. Supply and installation of anchors, ties and other accessories as specified and required by the works.
- E. Marble thresholds.

##### **1.2. RELATED REQUIREMENTS**

- A. Related Requirements:
  1. Section 079200 - Joint Sealers.



2. Section 092400 - Portland cement Plaster

#### **1.3. REFERENCE STANDARDS**

##### **A. Reference Standards:**

1. ANSI A118.4 - American National Standard Specifications for Latex-Portland Cement Mortar; 1999 (R2005).
2. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 1999 (R2005).
3. ASTM C 503 - Standard Specification for Marble Dimension Stone; 2008.

#### **1.4. SYSTEM DESCRIPTION**

##### **A. Performance Requirements:**

1. Provide and engineer anchorage and connections necessary to comply with size, arrangement and incorporation of marble wall facing with structure as indicated on drawings.
2. Ensure in design of stonework system that the concrete and concrete unit masonry backup is structurally adequate for proposed stone anchorage and support.
3. Determine interfacing required between systems specified in this section and the building structure to ensure specified performance. Obtain from the Engineer the predicted structural deflections, creep, stiffness, thermal movement and tolerances for all structure upon which the systems specified in this section are dependent.
4. Ensure that wall facing and connections withstand safety imposed wind, gravity loads, temperature and shrinkage stresses and other superimposed loads.
2. Temperature stresses shall be based on range of 5 deg. C to 55 deg. C ambient, and 85 deg. C for surfaces exposed to the sun. Provide calculations for thermal expansion and contraction.
3. Calculations for structural integrity shall be based on a factor of safety of 3 times the imposed loading in determination of adequacy of stone and 4 times the imposed loading for anchorage and support systems to prevent stone breakage, failure of anchorage or displacement of stone.
4. Independently secure/anchor each wall facing stone unit, notwithstanding its location, to ensure that the stone unit does not bear on or transmit loads to adjacent stones. Each wall facing stone unit shall be capable of supporting without increase in allowable stress the load of adjacent stones which have suffered a loss of their gravity load supports.
5. Reinforce bearing areas against diagonal tension, splitting, rupture, and flexure.
6. Provide anchorage and support for stone designed to meet performance requirements and as indicated on drawings. Alternative system with complete structural analysis and design data may be proposed for approval of Engineer whose decision will be final.
7. Provide connections to transfer forces to structure.
8. Ensure that facing sustains and transmits loads indicated in design criteria.

##### **B. Fabrication Tolerances:**

1. Fabrication facing units to the following tolerances:

- a. Variation of finished surfaces from true plane: measured under a 1200 mm long straightedge applied in any direction of 1 mm on polished, honed and smooth stone surfaces and 1.5 mm to normal plane of flamed surfaces.



- b. Variation from true plane at bed and joint arise lines: 1/6 of joint width or 1 mm.
  - c. Length of Stone Unit: + or - 1.5mm.
  - d. Height of Stone Unit: + or - 1.5mm.
  - e. Deviation from Square: with measurement taken using longest edge as base: + or - 1.5mm.
  - f. Critical Stone unit Thickness: + 3mm except for + 1.5 mm where end of stone is exposed to view.
  - g. Variation of Anchors and Fasteners from indicated position Shown: + 6mm.
  - h. No depressions in bed and joint faces shall occur within 9mm of face of unit, except that no depressions shall be present in bed faces of horizontal open joints.
- C. Installation Tolerances:
- 1. Install facing units to following tolerances:
    - a. Level and plumb + or - 3mm in any bay or storey height, or 6 m maximum distance.
    - b. Located from plan position shown + or - 3mm in any bay or 6 m maximum distance.
    - c. Opening sizes within 3mm of designated dimension
    - d. Align panel edges within 1.5mm.
- D. Allowable tolerances are non-cumulative.
- 1.5. SUBMITTALS
- A. See Section 013000 - Administrative Requirements, for submittal procedures
  - B. Shop Drawings: Indicate tile layout, patterns, colour arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, accessories, and setting details.
  - C. Samples
    - 1. Submit three 300 mm x 300 mm samples of each specified stone in each finish to Engineer office, and full size identical samples to site. Samples shall indicate extreme range of colour, texture and veining of stone intended for installation.
    - 2. Samples of stone shall demonstrate the maximum amount of sticking and filling to be expected when stone is fabricated.
    - 3. Acceptance of stone provided for the project will be determined within the range of approved samples.
    - 4. Submit additional samples as directed if required for testing verification.
  - D. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.
- 1.6. QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.
  - B. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.
- 1.7. MOCK-UP
- A. See Section 014000 - Quality Requirements, for general requirements for mock-up.
  - B. Construct tile mock-up where indicated on the drawings, incorporating all components specified for the location.



1. Minimum size of mock-up to be agreed with the Engineer.
2. Approved mock-up may remain as part of the Work.

**1.8. PRE-INSTALLATION MEETING**

- A. Convene one week before starting work of this section.

**1.9. DELIVERY, STORAGE, AND HANDLING**

A. Delivery:

1. Deliver stone units to site in the sequence required by the construction schedule for installation, to meet construction schedule, and to locations as directed. Verify construction schedule before fabrication commences.
2. Inspect stone units for damage upon delivery. Reject damaged units and remove from site.
3. Ensure that all supporting anchors, inserts, bolts, angles and other items required to be built into concrete and stone, and installed on steel framing, are delivered to the site, together with location drawings, in sufficient time so that job progress is not delayed.

B. Handling:

1. Pack and load stone units for shipment and unloading at site in a manner to prevent strains, hair cracks, micro fissures, abrasion, soiling, staining and other damage.
2. Do not move stone units with pinch or wrecking bars.
3. Use no material for blocking or packing which would stain or discolor exposed surfaces of the stone units.
4. Isolate stone units from contact with ground and other materials until laid, to prevent staining.
5. Lift stone units with proper and sufficiently long and wide slings with protection provided so that they are not damaged. Do not use wire ropes, or tarred or similarly treated ropes.
6. Protect edges and corners of stone units to prevent damage.

C. Storage:

1. Stack stone units on timbers or platforms at least 150mm above grade, above any possible water level, and so that weight is distributed to prevent damage to stone by over-stressing units.
2. Provide necessary means to prevent collection of dirt, soot, oil, grease; and staining of units during storage.
3. Place polyethylene or other plastic film between wood and finished surfaces of stone units when stored for an extended period of time.
4. Cover stored stone units to prevent soiling or damage.
5. Maintain stone units dry at all times while in storage and to ensure that no water collects in holes and reglets.
6. Stack stone units in order of erection so each may be individually inspected before installation.

D. Rejection of Defective Stone Units:

1. Inform Engineer upon receipt of any stone unit showing flaws or imperfections at the storage yard or building site for his review.
2. The Engineer may reject the unit or approve its redressing for use as suitable.
3. Remove rejected units from the site immediately.

E. Hoisting and Scaffolding:



1. Include in work of this section all hoisting facilities for the handling and installation of stone at the site and for scaffolding required for installation of stone work.

#### **1.10. SITE CONDITIONS**

##### **A. Environmental Conditions:**

1. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site, and cause no damage to the products specified in this section or to the performance of these products in use.
2. Follow recommendations of the supplier of the products.
3. Environmental conditions shall include, but shall not be limited to, ambient temperature; humidity; moisture in the air and on the products and surfaces with which they are in contact; moisture content of the products and materials with which they are in contact; and temperature of the products and the materials with which they are in contact.

#### **3.7.6.2 PART 2 - PRODUCTS**

##### **1.1. SETTING MATERIALS**

###### **A. Mortar:**

1. To meet specified requirements of section 040653: Mortar and Masonry Grout.

###### **B. Anchors, Cramps, Dowels, Brackets, Clips, Supports, and Fasteners:**

1. Stainless steel to meet specified requirements of BS 1449, part 2, 304S15, or ASTM A666, Grade B, 304, mill finish, for plates or straps; and BS 970, Part 1, Section Five, 304S15, or ASTM A276, Grade B, 304, for dowels and pins; and ASTM A193 for threaded rods: as required to sustain imposed loads, and minimum 4.8mm thick for flat bars.
2. Anchorage devices shall provide for variations in the relationship of stone units with the building structure without causing damage to the stone.
3. Fasteners shall meet acceptable standards as required to meet structural design calculations.

###### **C. Epoxy Adhesive:**

1. Latapoxy 210 by Laticrete
2. or equivalent approved.

###### **D. Joint Sealant, Primer and Backing:**

1. Materials shall meet specified requirements of Section 079200.
2. Quality Control of sealants is required as specified in Section 079200.

###### **E. Pre-formed Joint Filler:**

1. Closed cell, polyvinyl chloride foam, semi-rigid, to meet specified requirements of ASTM D1752.

###### **F. Sand:**

1. Mortar aggregate, evenly graded, with maximum size particle 3mm dia. And a minimum content of fines 0.15mm dia. And less; to meet specified requirements of BS 1199 and 1200, or ASTM C144.

###### **G. Slip Sheet:**

1. 0.15mm thick polyethylene film.

###### **H. Setting Bed Reinforcement:**



1. Minimum 1.5mm dia. Wire in welded 50mm x 50 mm mesh; to meet specified requirements of BS 4483, or ASTM A185.
  - I. Thin Set and Epoxy Bedding and mortar:
    1. Thin (Dry) Set Mortar: Bond coat to meet specified requirements of ANSI Standard A1118.1: Laticrete 4207 as manufactured by Laticrete 4207 as manufactured by Laticrete International Inc., or Kerabond by Mapei Canada Inc., or PCI-Non-Sag by Polychemie GmbH.
    2. Setting and Grouting Epoxy: To meet specified requirements of ANSI Specification A18.3, Laticrete 210 by Laticrete International Inc., or Epoxy PE12 by Mapei Canada Inc., or PCI Rigamols by PCI Polychemic GmbH
    3. Dry Curing Grout: Premixed, dry set, as recommended by tile supplier and to meet specified requirements of ANSI A118.1; Laticrete Floor Grout & Filler with 3701 additive as manufactured by Laticrete International Inc., or keracolour with Plastijoints additive by Mapei Canada Inc., or PCI-Flex-Grout by PCI Polychemie GmbH, or BCR Rainbow Grout by Building chemical Research Company.
    4. Epoxy Stone Joining Adhesive: Two component, 100% solids epoxy adhesive designed to provide permanent, water resistant bond, and as recommended by stone manufacturer.
    5. Local Suppliers:
      - a. The Contractor is permitted to use local suppliers of Fosroc, Feb, Expandite, Servicized, sika and Building Chemicals etc. For providing miscellaneous chemical material (like admixtures, surface treatments, grouts, resin anchors, repair compounds and mortars, flooring products, membranes and sealants, waterstops, adhesives and timber treatment etc.) subject that products offered meet the requirements of the relevant British Standards.
- 1.2. STONE
- A. Specified stone types are as referred to by generally recognized trade nomenclature and shall be obtained from quarries capable of supplying stone of quality, quantities, sequence and delivery dates required by the works.
  - B. Provide specified stone for the Project from the same location in the quarry and from the same period of quarrying.
  - C. Select stone to ensure that colour and veining is consistent throughout the Works.
  - D. Granite Quality Requirements:
    1. Limit size of inclusions in granite to a maximum of 15mm diameter. Limit edge chips to a maximum of 6 mm along each edge and a maximum depth of 3 mm.
    2. Finish surfaces shall have no visible evidence of machining or marks from mechanical polishing and abrasives.
    3. Veining and colour of adjacent units shall have a consistent uniform appearance. Acceptable veining, inclusions, and colour will be determined by inspection of units laid out at site of fabrication and by evaluation of sample mock-ups.
  - E. Marble:



**Qatar General Electricity & Water Corporation  
Tender No. GTC 626/2014  
Construction of Mega Reservoirs PRPSs  
(Package A, B, C, D & E)**

1. In accordance with requirements of ASTM C503-79, Classification I, Calcite, to meet following physical requirements:

PROPERTY TEST	REQUIREMENT	ASTM TEST
A. Absorption by Weight Maximum 5%	0.75	C97
B. Density, minimum kg/m <sup>3</sup> ; 1 Calcite:	2595	C97
C. Compressive strength, Minimum Mpa	52	C170
D. Modulus of rupture, minimum Mpa.	7	C99
E. Abrasion resistance,	10.0	C241

**1.3. STONE SEALER**

**A. Floor Sealer:**

- a. To meet specified requirements of ASTM C309, Type 1, Class B, for clear non-yellowing, transparent acrylic type liquid sealer; containing at least 20% methyl methacrylate or ethyl acrylate copolymer resin solids in xylol solvent.

**1.4. FABRICATION**

- A. Fabricate stone units within specified tolerances, of dimensions indicated on drawings, marked on consistent face that is concealed from view with date of fabrication and numbered in accordance with erection drawings, and as required for installation.
- B. Do not commence fabrication of stone work until shop drawing and sample submittals have been approved.
- C. Only a minimum amount of sticking and filling of marble will be acceptable and it shall match natural colour and veining of the stone.
- D. Provide holes for lifting stone units if required, and holes and cut-outs required for support clips, cramps, lewis bolts and other required anchoring.
- E. Allow for contraction and expansion within the limits of the joint material when cutting for anchorage devices.
- F. Locate holes for anchors no closer to surface of stone than required by design and such that no stresses are imposed on stone other than those allowed for in design.
- G. Anchorage type and spacing shown on drawings is nominal and is intended to indicate a system.
- H. Provide swan finish for backs of stone units.
- I. Ensure that beds and joints are free of other than minor depressions at mortar and diagonal joints, and of all depressions in bed faces of horizontal open joints.
- J. Fabricate stone units with full cut edges.
- K. Fabricate stone units to profiles indicated on drawings with true alignment of arises to maintain specified tolerances. Ease arises slightly.
- L. Provide stone facing units of greater thickness than indicated if required to maintain effective strength at anchors, cut-outs and bearing.



- M. Review proposed revisions to thickness, shape and size of stone units with Engineer before commencing preparation of shop drawings.
- N. Provide for joints in exterior cladding and in interior systems as indicated in the drawings. Unless otherwise indicated on drawings.
  1. All interior cladding joints are 3mm.
  2. All interior paving joints are 2mm.
- O. Provide saw cut false joints to depth and width indicated on drawings.
- P. Provide inlaid stone pattern work secured by epoxy adhesive as indicated on drawings.
- Q. Remove rust stains and iron particles from backs of stone units.
- R. Finish surface of stones exposed to view shall match approved samples by polishing or thermal (flame) treatment for locations indicated.
- S. Only stone with surfaces and edges which are free from cracks, scratches, chipped edges, broken corners and patches will be accepted. Remove stone units with any of above defects from site and replace with new units.
- T. Unless otherwise indicated on drawings granite/marble thicknesses are as follows:
  1. Interior flooring: 30mm.
  2. Interior wall panels to following minimum thicknesses: Interior panels with greater dimension not exceeding 750mm, 20mm; interior panels with greater dimension of from 750 to 1200mm and not exceeding 1.5m<sup>2</sup> in area, 25mm; panels with greater dimension of from 1200mm to 1600mm, and not exceeding 2 m<sup>2</sup> in area, 33mm; granite curbs, solid in dimensions as detailed. Maximum lengths; 10 times least dimension.
  3. Maximum acceptable variation in thickness of panels scheduled to be set in curtain wall system may not exceed +4.76mm -0mm on pieces less than 50 mm thick or +7.93mm on thicker pieces.
  4. Contractor is solely responsible for added setting bed, revised slab thickness, revised slab levels, and/or dimensions of backup structure to achieve finish dimensions shown on Contract Drawings. Full warranty shall be provided without exception or condition accordingly.

### 3.7.6.3 PART 3 - EXECUTION

#### 1.1. EXAMINATION

- A. Verify dimensions of installed work in the field to ensure that fabrication of stone units suits actual conditions before installation commences.
- B. Ensure that mechanical electrical and similar installations that penetrate stone are located so that proper cut-outs are provided in the stone.
- C. Examine existing construction that provides backup, support and anchorage for stone before installation commences. Ensure that conditions are satisfactory for installation of stonework to meet specified requirements. Do not proceed with installation of stone until unsatisfactory conditions have been rectified.
- D. This section shall review and approve shop drawings of items or assemblies related to the support or anchorage of stonework, including requirements for clearances for proper installation.



- E. Defective stone work resulting from installation under unsatisfactory conditions or incorporated with unsuitable prior construction will be considered the responsibility of those performing the installation of work of this section.
- F. Ensure that walls are clean and free from dirt, scale, or other deposits before commencing application of damproofing.
- G. Ensure that surfaces to receive stone are free of loose dirt, sand, bituminous materials, oil, grease and other foreign materials.

#### **1.2. PREPARATION**

- A. Supply information on handling methods and restrictions to Sub-contractors prior to installation of granite specified in this section.
- B. Co-ordinate with and assist section of cast-in place concrete in Civil and Structural Specifications to properly locate anchorage embedded in concrete.
- C. Securely fix in place strap anchors, clips, angles and hangers as required for proper support of stone.
- D. Cut, drill and fit stone units to accommodate the installation of work of other sections and as required. Cut and drill for other sections only as instructed by and to templates provided by the applicable section. Cutting and drilling shall not impair the strength and appearance of the stone unit, and shall be performed to match shop fabricated methods.
- E. Clean stone before installation with non-metallic bristle brushes. Rinse with a complete drenching with clean water. Use cleaning compounds only if necessary and only when they contain no caustic compounds or abrasive materials.
- F. Protection
  - 1. Take particular care to prevent staining of adjacent property, construction and surfaces by damproof coating materials. Replace porous materials from which soil from coating materials cannot be completely removed.
  - 2. Cover exposed tops of facing and parapet walls when work is not in progress and until protected by completed construction. Cover with non-staining waterproof material to overhang top edges of wall by 610mm minimum and secured to prevent dislodgement.
  - 3. Protect exposed external corners of stone with materials, which will not damage or soil finished surfaces.
  - 4. Protect exposed external corners of stone with materials, which will not damage or soil finished surfaces.
  - 5. Protect all finished surfaces from mortar droppings.

#### **1.3. INSTALLATION - GENERAL**

- A. Conceal all fastenings.
- B. Provide dielectric separation between dissimilar metals in contact.
- C. Secure stone with anchors, dowels, cramps, etc. As required for rigid and secure insulation.
- D. Except where provisions are indicated on drawings for removal of stone, set anchorage solidly in mortar.
- E. Mortar bed Setting of Pavers and Flooring.



1. Wet stone units before placing on mortar bed. Ensure that units have no water adhering to their surfaces when laid; but shall be wet only to ensure that complete hydration takes place during hot drying weather, and when unit absorption rates are greater than 60.11 ml/sq.cm/minute, so that the initial rate of absorption does not exceed above rate when laid.
2. When work is resumed at stone previously laid with mortar either partially or totally set, remove loose mortar from top and adjoining surfaces. Remove mortar completely when stone is removed and replaced with new.
3. At stone pavers, place mortar setting bed full depth and screen to levels required by finish elevation. Lay units dry over an area that can be checked with 3m long straight edge to determine level within specified tolerance. Correct levels by adjustment to setting bed if required. Lift units so checked and butter the back of them with thick paste of cement, sand and latex admixture before laying again in final position. Tamp units into proper level to ensure full bearing with no voids. Over insulation reinforce mortar bed with reinforcing mesh at centre of bed and completely embedded in mortar.
4. At stone interior flooring, place, level and compact sand bed. Install slip sheet with joints lapped a minimum of 50mm. Place mortar setting bed with reinforcing mesh at centre of bed and completely embedded in mortar, and proceed with adjusting of bed and laying of stone as specified herein before for pavers.
5. Remove and reset stones which when struck have a hollow sound after they have been installed to provide solid bedding.

**F. Mortar joints:**

1. Wet stones before setting with mortar joints. Ensure that no free water remains on joints to be filled with mortar.
  2. Set stones with bed and vertical joints filled solidly with mortar.
  3. Provide setting cushions in joints where weight of stone will cause mortar to be squeezed out.
  4. Except for paver and flooring units, rake out joints to a depth of 2-1/2 times their width but not less than 12mm to provide for pointing mortar.
  5. Clean out joints to be pointed to remove dirt and loose material and dampen joint surfaces.
  6. Provide a uniform depth to raked out joints by filling with pointing mortar in layers not exceeding 9mm. Apply pointing mortar in three layers; the first two layers consisting of 2/5 of joint depth. Allow each layer to cure "thumbprint" hard before applying succeeding layer. Tool joints slightly concave and smooth when mortar is "thumbprint" hard.
  7. Fill joints at paver and flooring units full depth and tool level and smooth when mortar is "thumbprint" hard.
2. Protect surfaced of stone adjacent to joints from mortar smears.

**G. Construction Joints:**

- A. Keep construction joints free from mortar.
- B. Caulk construction joints with sealant to meet specified requirements of section 07920.
- C. Where control and construction joints are indicated on drawings, install pre-formed joint filler for full depth of joint including setting bed with space at top of filler left for filling of joint with sealant. Line up joints with control and expansion joints provided in concrete structure and locate otherwise where indicated.



**1.4. INSTALLATION OF INTERIOR STONE FLOORING**

- A. Install stone units on concrete slabs with mortar bed setting and in conformance with CP 202 and with mortar joints.
- B. Provide control joints at locations indicated.
- C. Install stone flooring 20mm thick pavers in elevator car Nos. 1, 2, 3 with thin set bedding and grouted joints. Prime sub floor, and place and grout stone in strict accordance with thin set manufacturer's recommendations.
- D. Apply sealer to interior stone flooring which is thoroughly dry and clean, and free from oil, Grease and other foreign materials. Apply sealer in two coats by roller, brush or spray at rate of 7 to 10 square metres per litre as determined by porosity of granite.

**1.5. INSTALLATION OF STONE WALL FACING**

- A. Install interior wall facing units with sealed joints.
- B. Where horizontal stone panels bear on clips, make neoprene setting pads 1.6mm thick x full length of clip. Adhere fully and completely to bottom of stainless steel clip using suitable adhesive or by using self-adhering neoprene. Roll out flat leaving no air pockets or free areas, which are not adhered.
- C. Set horizontal stone panels where not bearing on clips with two setting cushions per unit in every horizontal joint, extending full depth of stone and to within the dimension from the face or required to permit installation of backing and sealant. Alternate the installation cushions using plastic in one horizontal course and neoprene in the next joint.
- D. Support diagonally coursed stones entirely by anchors.
- E. Keep cavities behind exterior facing panels free of mortar or other foreign material.

**1.6. FIELD QUALITY CONTROL**

- A. Refer to Section 014000 for quality control requirements.
- B. Inspect and report on mortar materials and on compressive strength of mortar samples as lying of masonry progresses. Provide six 50mm cubes of mortar from samples taken randomly at the site, for each test, as directed.
- C. Immediately following each inspection and/or testing submit a copy of reports to Engineer.

**1.7. ADJUSTMENT AND CLEANING**

- A. Clean Stone surfaces with water and soft bristle brushes immediately following stone installation and joint sealing to remove stains, dirt, mortar smears, sealant, and other foreign materials. Do not use cleaning compounds or wire brushes.
- B. Protect adjacent surfaces and property from damage while cleaning.

**1.8. ACCEPTANCE**

- A. The completed installation shall have the acceptance of the Engineer. Installed units which are chipped, cracked or otherwise damaged, which exceed approved appearance range, or which, in the opinion of the Engineer, do not conform to specification requirements shall be removed and replaced.



#### 1.9. PROTECTION

- A. Protect corners and edges of stone units that are vulnerable to damage by continuing construction. Protect them by means of wood or other rugged materials secured in a manner that will not damage or stain finish surfaces.
- B. Protect stone paving, flooring, fitment facing, steps, planters and fountain from damage by continuing work of this and other sections. Use only non-staining protection materials.
- C. Protect stone from staining and damage by concreting operations.
- D. Remove protection when risk of damage is no longer present and without damage to stone.

#### 1.10. EXTRA STOCK

- A. Maintain in stock for duration of warranty period a supply of stone for replacement. Quantity of stock shall provide not less than 5% additional to estimated quantities required for each stone type.

### **3.7.7 SECTION 09 51 23 - ACOUSTICAL TILE CEILINGS**

#### 3.7.7.1 PART 1 - GENERAL

##### 1.1. SECTION INCLUDES

- A. Supply and install suspension system and Gypsum tiles in locations as indicated on Drawings, Schedule of Finishes.

##### 1.2. RELATED SECTIONS

- A. Related Sections:

1. Civil & Structural Specifications: Cast-In-Place Concrete
2. Section 092900: Gypsum Board
3. Section 092216: Non-Structural Metal Framing

##### 1.3. STANDARDS

- A. Related Standards:

1. ASTM C635-87 Specification for metal Suspension Systems for Acoustical Tile and Lay-in Panels.
2. ASTM C 636-86 Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay -in Panels.
3. ASTM E 84 Surface Burning Characteristics.
4. CAN BS476/ CGSB-92.1-M89 Sound Absorptive Prefabricated Acoustical Units.
5. CSA 182.30-M1980 Interior Furring, Lathing and Gypsum Plastering.

##### 1.4. DESIGN

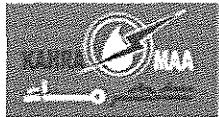
- A. Design suspension systems to carry safely and without distortion, superimposed loads of lighting fixtures, air supply diffusers and return grilles. Design suspension system to local regulations and submit necessary certifications.

##### 1.5. SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Shop Drawings:

1. Submit shop drawings in accordance with the requirements of Section 01300 Submittals.



2. Submit shop drawings showing framing, panel layout and installation details.
  3. Include hanger insert layout with insert type and weight supported indicated for each insert.
  4. Alternatively provide layout of suspension from cold rolled sections secured to block wall supports.  
Obtain the Engineer written approval for each system.
  5. Submit 10 year warranty certificate as mentioned in 2.2
- C. Samples:
1. Submit minimum 500 mm long samples of each specified exposed member and finish.
  2. Submit to site samples of support framing, hangers and hanger inserts.
  3. Submit maintenance instructions.
- 1.6. DELIVERY, STORAGE, AND PROTECTION
1. Package finishes materials.
  2. Store materials in protected dry areas.
  3. Ensure that finish metal members are not bent, dented, or otherwise deformed.
- 1.7. ENVIRONMENTAL REQUIREMENTS
- A. Environmental Conditions
1. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site, and cause no damage to the products specified in this section or to the performance of these products in use.
  2. Follow recommendations of the supplier of the products.
  3. Environmental conditions shall include, but shall not be limited to, ambient temperature; humidity; moisture in the air and on the products and surfaces with which they're in contact; moisture content of the products and materials with which they are in contact; and temperature of the products and the materials with which they are in contact.
- 1.8. WARRANTY
- A. See Section 017700 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

#### 3.7.7.2 PART 2 - PRODUCTS

##### 1.1. MANUFACTURERS

- A. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
- B. Refer Schedule of Finishes for locations and ceiling type and manufacturer / supplier information.
- C. Substitutions: See Section 016000 - Product Requirements.

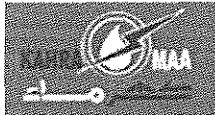
##### 1.2. CEILING TILES

- A. METAL MICROPERFORATED CEILING TILE WITH ACOUSTIC INLAY ON CONCEALED CLIP IN GRID:-600 x 600 mm
1. Manufacturers: Armstrong, Cloisal I,kingspan or equal approved .
  2. Structural Soffit (s): to concrete Slab / beam soffit and/or structural steelwork
  3. Include for acoustical insulation blanket over ceiling (BI: 04)



4. Aluminium Ceiling to comply with ISO9001
  5. Finished Thickness: 1.0 mm
  6. Perforated 1.8 mm Ø opening 20 %
  7. Bevelled Edge
  8. Clip in Installation
  9. Colour: RAL 9010 (White)
  10. Surface Finish: Polyester Powder Coated Finish.
- B. METAL NON-PERFORATED CEILING TILE ONCONCEALED CLIP IN GRID:-600 x 600 mm
1. Manufacturers: Armstrong, Cloisall, kingspan or equal approved.
  2. Structural Soffit (s): to concrete Slab / beam soffit and/or structural steelwork
  3. Include for acoustical insulation blanket over ceiling (BI: 04)
  4. Aluminium Ceiling to comply with ISO9001
  5. Finished Thickness: 1.0 mm
  6. Non- perforated (Plain Ceiling Panels)
  7. Bevelled Edge
  8. Clip in Installation
  9. Colour: RAL 9010 (White)
  10. Surface Finish: Polyester Powder Coated Finish
- 1.3. EXPOSED GRID SYSTEM
- A. Fabricate grid system to ASTM C 635, intermediate duty, from commercial quality, cold-rolled steel, exposed surfaces Prefinished as specified herein.
- B. Suspension System for Gypsum Ceiling Panels and Tile to profiles indicated on Product Schedule including the following characteristics:
1. Interlocking tee system designed to support acoustical panels in patterns indicated.
  2. Minimum 0.43 mm thick metal roll-formed into a double web design with a rectangular top bulb
  3. Cross tees shall be companion component of same depth and length to suit specified panel, and complete with high tensile steel end clinched to web.
- C. The system shall provide lock joint intersections of cross and main tees.
- 1.4. SUSPENSION SYSTEM
- A. Exposed grid: For 600 x 600 mm tiles; exposed tee grid, baked satin white. At high humidity areas, use satin-anodized aluminium exposed tee.
- B. Concealed grid: For 600 x 600 mm tiles; concealed grid, baked satin white.
- C. Inserts to steel members above: Provide inserts or Hilti fixation. Provide additional steel members crossing purlins, beams or joists with full support from structure to support ceiling system.
- D. Rod hangers: 5 mm, galvanized steel and anodized aluminium as applicable.
- E. Tie Wires: Min. 1.62 mm galvanized, annealed wire.
- F. Metal Edge Trim: Min. 0.064 mm cold rolled steel, factory-finished, satin-white.

#### 3.7.7.3 PART 3 - EXECUTION



#### **1.1. EXAMINATION**

- A. Examine work area before commencing installation of suspended ceilings to ensure that services have been installed, that construction integrated with ceilings has been provided in accordance with requirements for ceiling installation, that fastenings and supports installed by other are in place and that installations of others will not touch the back of ceiling system.
- B. Ensure that all wet work including concrete and plastering is completed and dry before installing ceiling.
- C. Ensure that environmental conditions are adequate for ceiling installations and building is enclosed. Maintain ranges of 60oF to 85o F with relative humidity not more than 70%; to be maintained prior to, during and after installation.
- D. Install ceiling panels and metal suspension system in accordance with applicable requirements of ASTM C 636 and manufacturer's directions.

#### **1.2. INSTALLATION**

- A. Coordinate installation of ceiling systems specified in this section with that of other sections. Ensure that adequate preparation is made for attachment of hangers and fasteners. Provide for support and incorporation of flush-mounted and recessed service components. Ensure adequacy of supports by consultation and verification of methods and locations of installations specified in divisions 15 and 16.
- B. Install ceiling system in accordance with manufacturer's recommendations.
- C. Hangers
  - 1. Install hanger anchoring inserts in formwork before concrete is poured.
  - 2. Install expansion bolt sleeves in drilled holes for ceiling hangers where embedded hangers are inaccessible and for additional hangers required for installation.
  - 3. Secure threaded hangers or eyebolts to anchors, locked in place to prevent loosening by vibration. Where eyebolts are used, tie hangers securely to eyebolts.
  - 4. Install hangers free of kinks and at no more than 5 degrees off vertical.
  - 5. Install extra hangers where required to support loads additional to ceilings.
  - 6. Do not support ceilings from, nor make attachment to, ducts, pipes, conduit, or support framing of equipment or services.
  - 7. Install the entire hanger system and/or suspension grid to adequately support the ceiling assembly, including services incorporated, with a maximum specified deflection for each component member, and free from horizontal movement.
  - 8. Install ceilings within 3 mm of dimensioned height above floor unless approved otherwise and level within a maximum tolerance of 3 mm in 3m.
- D. Lay out ceilings symmetrically and evenly spaced in each area and provide shadow reveal gap between ceilings of different type, and between ceilings and other elements, e.g.: walls columns, bulkheads etc. Set out ceiling grids square about room axes, columns and service elements, unless otherwise indicated on drawings.
- E. Frame around openings on each side, providing clearances for other installations only after verification of requirements in each case.
- F. Maintain true surface planes, and component and joint lines throughout each area.



- G. Butt joints between components tightly together, do not lap or over-sail plates at joints.
- H. Do not install exposed members that are bent or dented, or any exposed component that is stained, soiled, marred or defaced in any manner.
- I. Brace system to maintain alignment of grid.
- J. Install perimeter edge reveal at all wall interfaces to align with ceiling tile. Kerb tile in accordance with shop drawings. Installation to occur without distortion in wall alignment.

#### 1.3. CLEANING

- A. Clean soiled or discoloured surfaces of exposed ceilings surfaces on completion of ceiling installation.
- B. Replace exposed components which are visibly damaged marred or un-cleanable.
- C. Final Cleaning is specified in Section 017100.

### **3.7.8 SECTION 09 65 19 - RESILIENT FLOORING**

#### 3.7.8.1 PART 1 - GENERAL

##### 1.1. SECTION INCLUDES

- A. Supply and installation of resilient sheet and tile flooring and accessories, and resilient base as indicated on Drawings, Schedule of Finishes and as specified herein.
- B. Installation accessories.

##### 1.2. RELATED REQUIREMENTS

- A. Related Requirements:

1. Civil & Structural Specifications - Cast in Place Concrete
2. Section 092900 - Gypsum Board Assemblies

##### 1.3. REFERENCE STANDARDS

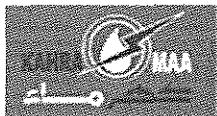
- A. Reference Standards:

1. ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2008.
2. ASTM F 1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004.
3. ASTM F 1861 - Standard Specification for Resilient Wall Base.
4. ASTM F 1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004.
5. ASTM F 2034 - Standard Specification for Sheet Linoleum Floor Covering; 2003.
6. FS SS-T-312B, Tile, Floor Asphalt, Rubber Vinyl and Vinyl Composition.
7. FSSS-W-40A, Wall Base: rubber and Vinyl Plastic.

##### 1.4. SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Submit samples of each specified flooring, base and accessories.
- C. Submit full size tiles.
- D. Submit base and accessories in lengths of 300mm
- E. Maintenance Data. Include maintenance procedures, recommended maintenance materials and suggested schedule for cleaning, stripping and re-waxing.
- F. Substrate Test Reports. Submit test reports of each test

##### 1.5. DELIVERY, STORAGE and PROTECTION



- A. Package flooring materials and identify contents of each package.
  - B. Store materials for a minimum of 24 hours immediately before installation at not less than 18 deg. C.
- 1.6. FIELD CONDITIONS**
- A. Adapt techniques approved by the Employer's Representative to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site and cause no damage to the products specified in this section or to the performance of these products in use.
  - B. Follow recommendations of the supplier of the products.
  - C. Environmental conditions shall include, but shall not be limited to, ambient temperature, humidity, moisture in the air and on the products and surfaces with which they are in contact, moisture content and temperature of the products and the materials with which they are in contact.
  - D. Ensure that adequate ventilation is provided during installation of flooring and curing of adhesive.
  - E. Ensure that spark-proof electrical equipment is provided and smoking is prohibited, in areas where flammable adhesives are used. Store material to prevent spontaneous combustion.
- 1.7. QUALITY ASSURANCE**
- A. Qualifications. Provide resilient flooring specified in this section only by a firm who has adequate equipment and skilled tradesmen to perform it expeditiously and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past five years.
- 1.8. EXTRA MATERIALS**
- A. See Section 016000 - Product Requirements, for additional provisions.
  - B. Deliver to Employer's Representative on completion of maintenance period and as he directs, 2% of the quantity of resilient flooring and resilient base installed, of each material and colour, in labelled packages.
- 3.7.8.2 PART 2 - PRODUCTS**
- 1.1. SHEET FLOORING**
- 1. Refer to Drawings, Schedule of Finishes for information on sheet flooring products acceptable for this project.
  - 2. Vinyl Sheet Flooring: Homogeneous without backing, with colour and pattern throughout full thickness, and:
    - a. Minimum Requirements: Comply with Minimum EN 649 (34-43).
    - b. Total Thickness and Wear Layer Thickness: 2.0 mm nominal.
    - c. Sheet Width: 2000 mm minimum.
  - 3. Linoleum Sheet Flooring: Homogeneous wear layer bonded to backing, with colour and pattern through wear layer thickness:
    - a. Minimum Requirements: Comply with ASTM F 2034, Type corresponding to type specified.
    - b. Backing: Jute fabric.
    - c. Wear Layer Thickness: 2.0 mm, minimum, excluding backing.
    - d. Seams: Heat welded.
    - e. Manufacturers:

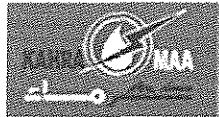


- 1) Acceptable manufacturer Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Employer's Representative.
  - 2) Substitutions: See Section 016000 - Product Requirements.
  4. Vinyl Welding Rod: Solid vinyl bead produced by manufacturer of vinyl flooring for heat welding seams, in colour matching field colour.
  5. Linoleum Welding Rod: Solid colour linoleum produced by flooring manufacturer for heat welding seams, in colour in colour matching predominant flooring colour
- 1.2. RESILIENT BASE
- A. Resilient Base.
1. Refer Drawings, Schedule of Finishes for Type of base used with resilient flooring.
  2. Acceptable manufacturer Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Employer's Representative.
  3. Substitutions: See Section 016000 - Product Requirements.
- 1.3. ACCESSORIES
- A. Ensure that accessories are compatible with and match colour and thickness of abutting flooring material.
- B. Reducer Strips. Bevelled, 25 mm wide, vinyl.
- C. Carpet Edge Strip. 25mm wide vinyl, to suit carpet thickness, bevelled.
- D. Subfloor Filler. Type recommended by adhesive material manufacturer.
- E. Primers, Adhesives and Seaming Materials. Waterproof; types recommended by flooring manufacturer.
- F. Sealer. Types recommended by flooring manufacturer.
- G. Cleaner. Types recommended by flooring manufacturer. Neutral chemical compound that will not damage tile or affect its colour.
- H. Floor Protection. Heavy paper laminated with non-staining adhesive to both sides of glass fibre reinforcing ply, minimum weight of 0.18 kg/sq.m.

#### 3.7.8.3 PART 3 - EXECUTION

##### 1.1. EXAMINATION

- A. Test substrate by methods recommended by manufacturer to ensure that moisture level and acid- alkali balance does not exceed limits recommended by adhesive manufacturer. Submit results of tests to Employer's Representative.
- B. Verify that environmental conditions have been provided as requested and specified.
- C. Verify that subfloors have been provided as specified without holes, protrusions, cracks greater than 0.2 mm wide, unfilled control joints, depressions greater than 3mm deep, or other major defects.
- D. Defective resilient flooring resulting from application to unsatisfactory surfaces will be considered the responsibility of this section. Remove and replace defective flooring.



#### **1.2. PREPARATION**

- A. Remove dirt, soil, oil, grease and other deposits which would lessen the adhesive bond of flooring and which would telegraph through flooring.
- B. Remove chalking and dusting from concrete surfaces with wire brushes.
- C. Fill minor defects such as cracks, depressions and scars from damage with filler and level to smooth surface.
- D. The floor shall be levelled to the satisfaction of the Employer's Representative.
- E. Prime subfloors if recommended by adhesive manufacturer and as he specifies.
- F. Protection. Prevent traffic and work on newly laid floors by barricading until adhesive is cured.
- G. Prepare sub-floor surfaces as recommended by flooring and adhesive manufacturers.

#### **1.3. INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints tightly.
- E. Set flooring in place; press with heavy roller to attain full adhesion.
- F. Where types of floor finish, pattern, or colour are different on opposite sides of door, terminate flooring under centreline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

#### **1.4. INSTALLATION - GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Spread only enough adhesive to permit installation of materials before initial set.
- C. Apply adhesive uniformly over surfaces with a notched trowel, at rate recommended by manufacturer.
- D. Clean trowels and maintain profile of notches as installation of flooring progresses to ensure a constant rate of application
- E. Set flooring in place; press with heavy roller to attain full adhesion. Roll in two directions from center of area. Maintain rollers clean and polished.
- F. Cut flooring and bases to fit within 0.4 mm of abutting surfaces where exposed to view.
- G. Avoid abrupt variations in shades between adjacent flooring materials. Do not install units that are off-colour or contain untypical pattern variations.
- H. Carry floor patterns through openings.
- I. Clean trowels and maintain profile of notches as installation of flooring progresses to ensure a constant rate of application
- J. Coordinate with other Divisions for installation of equipment, floor drains, floor boxes, junction boxes and related equipment and accessories. Ensure that the floor is flush with surroundings.
- K. Finish seams in linoleum by heat welding.



**1.5. INSTALLATION - RESILIENT BASE**

- A. Install bases in lengths as long as possible; do not make up runs of short lengths.
- B. In areas where bases are indicated, install them on columns and walls
- C. Cut and mitre internal corners.
- D. Double cut seams between adjoining lengths.
- E. Apply adhesive to wall, masked to prevent spreading above base and firmly bed base in place.

**1.6. INSTALLATION - REDUCER AND CARPET EDGE STRIPS**

- A. Install reducer strips at terminations of flooring where edges are exposed to view.
- B. Install carpet edge strips where resilient tile flooring abuts carpet.
- C. Install strips in straight lines and relate their terminations to significant building features and within a tolerance of 3mm in 3m.
- D. Install strips under doors at openings.
- E. Cut and fit strip terminations to profile of abutting construction.
- F. Secure strips to subfloor with contact bond adhesive to ensure complete bond.

**1.7. ADJUSTMENT, CLEANING, SEALING AND WAXING**

- A. Remove excess adhesive from floor, base and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.
- C. Replace defective resilient flooring installations so that there is not discernible variation in appearance between installed and replaced materials.
- D. Clean, seal and wax resilient flooring products in accordance with manufacturer's instructions.

**1.8. PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.
- B. At completion of flooring installation, install floor protection in areas where finishing operations, repairs and installation of equipment and foot traffic will occur. Lap joints of material by 150 mm and seal with non-asphaltic tape.

**1.9. SCHEDULE**

- A. Refer to Drawings, Schedule of Finishes.

**3.7.9 SECTION 09 68 13 - CARPET TILE**

**3.7.9.1 PART 1 - GENERAL**

**1.1. SECTION INCLUDES**

- A. Carpet tile, fully adhered.

**1.2. RELATED REQUIREMENTS**

- A. Related Requirements:

- 1. Civil & Structural Specifications - Cast-in-Place Concrete

**1.3. REFERENCE STANDARDS**

- A. Related Standards:



1. ASTM D 2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2006.
  2. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.
  3. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2008.
  4. CRI 104 - Standard for Installation of Commercial Textile Floor covering Materials; Carpet and Rug Institute; 2002.
  5. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association; 2006.
- 1.4. SUBMITTALS**
- A. See Section 013000 - Administrative Requirements, for submittal procedures.
  - B. Shop Drawings:
    1. Submit shop drawings showing locations of rooms and areas requiring carpet. Indicate layout of seams and edging. Provide 1:1 scale details of transition strips to dissimilar materials.
    2. Submit data and reports of an approved testing laboratory to validate that specified testing criteria has verified that carpet intended for installation meets specified performance requirements.
  - C. Sample: Submit 3 samples in suitable size of each carpet type specified to Engineer for approval.
    1. Submit two, 300 mm long samples of edge strip.
  - D. Performance Reports:
    1. Submit data and reports of an approved testing laboratory to validate that specified testing criteria has verified that carpet intended for installation meets specified performance requirements.
  - E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- 1.5. FIELD CONDITIONS**
- Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site, and cause no damage to the products specified in this section or to the performance of these products in use.
- A. Follow recommendations of the supplier of the products.
  - B. Environmental conditions shall include, but shall not be limited to, ambient temperature; humidity; moisture in the air and on the products and surfaces with which they are in contact; moisture content of the products and materials with which they are in contact; and temperature of the products and the materials with which they are in contact.
  - C. Ensure that adequate ventilation and spark-proof electrical equipment are provided, and smoking is prohibited, in areas where flammable liquids are used. Store materials to prevent spontaneous combustion.
- 1.6. DELIVERY, STORAGE AND HANDLING**
- A. Package carpet materials & label each package to indicate contents. Include register number on each carpet label.
  - B. Deliver carpet materials to the site only immediately before installation, but to allow time for complete acclimatization.



- C. Protect carpet during storage and handling to ensure that it is not damaged or soiled.
- D. Store materials in protected dry area.

### **3.7.9.2 PART 2 - PRODUCTS**

#### **1.1 MANUFACTURERS**

- A. Acceptable manufacturer Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
- B. Design Based Refer to Drawings, Schedule of Finishes for information on types and manufacturer/supplier details.
- C. Substitutions: See Section 016000 - Product Requirements.

#### **1.2 MATERIALS**

##### **A. General:**

- 1. Provide carpet with no variation in colours and patterns from approved samples.
- 2. Permanently treat carpet materials to ensure resistance to insect attack.

##### **B. Carpet Tiles:**

- 1. Refer to Drawings, Schedule of Finishes for information on types and other related details.

#### **1.3 ACCESSORIES**

##### **A. Edge Trim:**

- 1. Zinc Strips as indicated in the drawings.

##### **B. Threshold Strips:**

- 1. Provide Aluminium threshold strip at joints between different flooring material.

##### **C. Adhesive:**

- 1. Type recommended by manufacturer of carpet as suitable for carpet backing and substrate.

### **3.7.9.3 PART 3 - EXECUTION**

#### **1.1 EXAMINATION**

##### **A. Before commencement of carpet laying, ensure that:**

- 1. Construction and installations of others in areas where carpet is installed has been completed and is satisfactory for installation of carpet.
- 2. Floors are level, and free from cracks, ridges, dust, oil, grease, debris and other soil which would harm installation.
- 3. Concrete floors and screeds are cured and free of dusting.
- 4. Moisture content of concrete slabs and compatibility of sealer meets requirements of adhesive manufacturer.
- 5. Environmental conditions meet specified requirements.

#### **1.2 PREPARATION**



- A. Grind or sand ridges and high spots level and smooth.
- B. Fill holes, cracks or other irregularities remaining from surface finishing performed by other sections with filler suitable for substrate material. Level subfloor to openings with filler.
- C. Remove soil, oil, grease, wax, paint and similar foreign materials from surfaces to receive carpet.
- D. Vacuum clean surfaces to receive carpet with an industrial type machine.
- E. Cover or mask surface adjacent to those receiving application of adhesive to protect them from soil.
- F. Damp mop surfaces before application of adhesive.

#### **1.3. INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Layout carpet to ensure that possible colour variations are distributed to appear inconspicuous, and that pile direction is the same in each separate area.
- C. Install carpet tile in accordance with manufacturer's instructions and CRI 104.
- D. Blend carpet from different cartons to ensure minimal variation in colour match.
- E. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- F. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- G. Locate change of colour or pattern between rooms under door centerline.
- H. Fully adhere carpet tile to substrate.
- I. Trim carpet tile neatly at walls and around interruptions.
- J. Complete installation of edge strips, concealing exposed edges.

#### **1.4. CLEANING**

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

#### **1.5. EXTRA STOCK**

- A. Deliver to Client on completion of maintenance period and as he directs, surplus materials to the minimum amount of 5% of the quantity of carpet tiles installed, of each specified carpet of each colour, and in labelled packages.

### **3.7.10 SECTION 09 69 00 – ACCESS FLOORING**

#### **3.7.10.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Work of this section includes, but is not limited to: access floor panels, floor coverings, under structure and various electrical, data and communication accessories.

##### **1.2. RELATED SECTIONS**

- A. Concrete sealing shall be compatible with pedestal adhesive, see Civil & Structural Specifications.
- B. Electrical contractor shall provide necessary material and labour to electrically connect the access floor to the building, see Electrical Specifications if necessary.

##### **1.3. ENVIRONMENTAL CONDITIONS FOR STORAGE & INSTALLATION**



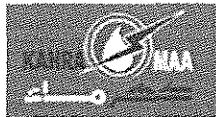
- A. Area to receive the access floor shall be enclosed and maintained at ambient temperature between 15° to 25° C, and at a relative humidity level between 40% to 65% and shall remain within these environmental limits throughout installation and occupancy. All laminated floor panels shall be stored and maintained within these limits upon delivery to storage sites. All bare floor panels shall be stored in this environment at least 24 hours before installation begins.
- 1.4. REFERENCES
  - A. RAL-GZ 941 (German Institute for Quality Assurance and Marketing) - "Access Floors Quality Assurance" shall be used as a guideline when presenting load performance product information.
  - B. Access flooring shall comply with EN 13501 respectively DIN 4102 Part 1 (reaction to fire performance) and Part 2 (fire resistance performance) requirements for access flooring.
- 1.5. PERFORMANCE SPECIFICATIONS
  - A. Product tests shall be witnessed and certified by independent engineering and testing laboratory based in Germany with a minimum of five years experience testing access floor components in accordance to RAL-GZ 941 standard. Continuous documentation of the quality assurance including external quality controls must be ensured.
- 1.6. PRODUCT MARKING
  - A. Floor panels shall be permanently marked with manufacturer's name, product identification, manufacturing date. Removable Product ID stickers are not acceptable.
- 1.7. PERFORMANCE REQUIREMENTS
  - A. Pedestals:
    - 1. Axial Load: Pedestal assembly shall sustain a 20 kN axial load without permanent deformation.
    - 2. Overturning Moment: Pedestal assembly shall provide an average overturning moment of 50 Nm when glued onto a clean concrete surface.
    - 3. Corrosion Protection: Pedestal assemblies shall meet the requirements for corrosion protection in accordance to DIN 50021ss > 72 hours. The compliance has to be certified.
  - B. Floor Panels:
    - 1. Concentrated Load: Panel shall be capable of supporting an average concentrated load of 5,500 N placed on a 625 sq/mm indentor in the centre of the panel with a maximum top surface deflection of 2.0 mm. Panel shall not exceed a permanent set of 0.25 mm, after the load is removed. Panel shall demonstrate ductility by being loaded to a deflection of 2.0 mm without incurring damage.
    - 2. Ultimate Load: Panel shall be capable of withstanding an average concentrated load of 12,500 N applied onto a 625 sq/mm indentor in the centre of the panel without failure. Failure is defined as the point at which the panel will no longer accept the load. Certified test shall be provided attesting to this ultimate load.
    - 3. Rolling Load: Panel and supporting understructure shall be able to withstand the following rolling loads at any location on the panel without developing a local and overall surface deformation greater than 1.0 mm. Note: wheel 1 and wheel 2 tests shall be performed on two separate panels.
      - a. Wheel 1: Size: Ø 76.2 mm x 45.9 mm Load: 3,500 N Passes: 10
      - b. Wheel 2: Size: Ø 152.4 mm x 38.1 mm Load: 3,500 N Passes: 10,000



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**Construction of Mega Reservoirs PRPSs**  
**(Package A, B, C, D & E)**

4. Fire Resistance: Panels shall meet REI 30 respectively F 30 fire resistance (30 minutes fire resistance). Tests shall be performed in accordance with EN13501 respectively DIN 4102 Part 2, European and German Fire Safety Standard and has to be certified. Any metal connection from bottom to the topside of the panel is not acceptable because of the heat transfer to the surface in case of fire.
5. Non-combustibility: Panels shall meet Class A fully non-combustible. Tests shall be performed in accordance with EN 13501 respectively DIN 4102 Part 1, European and German Fire Safety Standard and has to be certified. System shall meet Class A Flame spread requirements for flame spread and smoke development. Tests shall be performed in accordance with ASTM-E84-1998, Standard Test Method for Surface Burning Characteristics for Building Materials and has to be certified.
6. Seismic safety: The floor shall be able to withstand seismic loads acc. to International Building Code. Significant test certificate shall be provided.
7. Biological Safety: Panels shall be approved as "Recommended by the IBR". Health and ecological aspects have to be considered for recommendations of the product. An examination is to be carried out for lindane, pentachlorphenol, formaldehyde, heavy metals and more. Tests shall be performed in accordance to the regulations of IBR (Institut für Baubiologie Rosenheim GmbH, Germany) and panels shall meet the Product Emission Test tested in accordance to ASTM 5116 (no cancer-causing emissions) and has to be certified. The waste material shall be fully recyclable.
8. Air Leakage: If the cavity underneath the floor system will be used as an air plenum or if some under floor air conditioning systems are used, the floor system shall meet the air leakage rate of 0.2 l/sm<sup>2</sup> without using special assemblies or coverings (lab test at 25 Pa). Significant test certificate shall be provided.
9. Electrical Resistance: The panel itself (without covering) shall provide a resistance to earth  $> 106 \Omega$  acc. DIN EN 1081 to protect against dangerous electrical shocks. For protecting persons against electrical shocks, lower values are not acceptable.
10. Effect of high temperature and high humidity: The panel shall be capable to meet the requirements when tested in accordance to PSA MOB PF2 PS/SPU March 1992 under the following testing conditions: 40° C +/- 2° C and 95 % r. h. +/- 2% r. h. for 7 and 14 days. Significant test certificate shall be provided.
11. Acoustical performance: The panel shall meet the following acoustical values when tested in accordance to EN ISO 140. The compliance has to be certified. Sound absorption value according to EN ISO 140:

Rated degree of longitudinal sound reduction Dnfw	50 dB	51 dB
		(VM = 27 dB)
Degree of improvement in footfall sound $\Delta Lw$	12 dB	26 dB
		(VM=27 dB)



Rated footfall sound level L <sub>nfw</sub>	72 dB	51 dB (VM=27 dB)
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#### 1.8. DESIGN REQUIREMENTS

- A. Access floor system, where indicated on the design documents, shall consist of modular and removable calcium sulphate panels supported by adjustable height pedestal assemblies forming a modular grid pattern.
- B. Panel shall be easily removed by one person with a standard lifting device and shall be interchangeable except where cut for special conditions.
- C. Quantities, finished floor heights (FFH) and location of accessories shall be as specified on the contract drawings.

#### 1.9. SUBMITTALS FOR REVIEW

- A. Detail sheets, for each proposed product type, which provide the necessary information to describe the product and its performance.
- B. Test reports, certified by an independent testing laboratory with a minimum of five years experience testing access floor components as specified above (e. g. concentrated load, fire- resistance, building- material, biological safety, air leakage).

#### 1.10. SUBMITTALS FOR INFORMATION

- 1. Manufacturer's installation manual.
- 2. Manufacturer's user guideline outlining recommended care and maintenance procedures.

#### 3.7.10.2 PART 2 - PRODUCTS

##### 1.1. MANUFACTURERS

- A. Access floor system shall be as manufactured by LINDNER AG - Germany and shall consist of the NORTEC G 30 ST panel supported by a stringerless understructure system.
- B. Alternative products shall meet or exceed the feature requirements as indicated herein and must receive prior written approval by the Engineer.
- C. Substitutions: See Section 016000 - Product Requirements.

##### 1.2. SUPPORT COMPONENTS

###### A. Pedestals:

- 1. Pedestal assemblies shall be galvanized and yellow chromatised (minimum 5  $\mu$  thickness), all steel welded construction, and shall provide an adjustment range of +/- 30 mm for finished floor heights as indicated in the drawings.
- 2. Pedestal assemblies shall provide a means of levelling and locking the assembly at a selected height, which requires deliberate action to change height setting and prevents vibration displacement.
- 3. Galvanized and yellow chromatised steel pedestal head shall be welded to a threaded rod or to the pedestal tube that includes a specially designed adjusting nut. The nut shall be firmly locked by using locking glue, such that deliberate action is required to change the height setting.



4. Galvanized pedestal base assembly shall consist of a formed steel plate with a size not less than 75 x 75 mm of bearing area, fixed to a steel tube or threaded rod.
  5. Pedestals head plate shall be designed for multiple purposes such as fixing hinged in stringers and screwed stringers without changing the head plate assembly.
- B. Stringers:
1. Stringers are required only for floor heights of more than 500 mm. Lower floor systems shall be designed as a stringerless floor system to provide easy access to the floor void.
  2. Stringers shall support each edge of panel.
  3. Steel stringers shall be galvanized.
  4. Stringers shall be individually and rigidly fastened to the pedestal with a clip in function or additionally screwed for each stringer. Positive electrical contact shall be provided between the stringers and pedestals.
  5. Stringer grid shall be 600 x 600 mm ensuring maximum lateral stability in all directions.
- 1.3. PANEL COMPONENTS
- A. Floor Panels:
1. NORTEC G 30 ST panels: Shall consist of a monolithic homogeneous fibre reinforced calcium sulphate material, 30.5 mm thick, a galvanized steel sheet shall be securely bonded to the bottom side of the panel. Calcium sulphate shall consist of approx. 99% recycled materials, i.e. FDG-gypsum (no natural gypsum) and kraft paper. The panels should be bare finished on top to receive off grid carpet tiles. The application of any factory bonded floor covering must be ensured. Panels have to be equipped with self-extinguishing edge trim. In case of factory bonded coverings the covering must be protected through the edge trim. Any metal edge trim is not acceptable.
  2. Panel size: 600 x 600 mm.
  3. Panels shall be bare finished or finished with factory bonded floor coverings.
  4. Panel edge trim shall be either conductive or non-conductive depending on the top covering.
  5. The edge trim shall be securely fixed to the panel without using harmful adhesive materials. In case of using factory bonded floor coverings, especially elastic, HPL, ceramic or parquet coverings the edge trim shall protect the full panel and covering area. The edge trim material shall be self-extinguishing in case of fire.
  6. The edge trim shall be provided in standard black colour, unless ceramic and parquet coverings are used. In this case the edge trim colour shall be similar to the covering colour.
  7. NORTEC sonic ventilation panels: Perforated calcium sulphate panels designed for static loads shall be interchangeable with standard field panels and capable of supporting concentrated loads with at least the same load carrying capacity like the standard panel. Panels shall have different open surface areas (4 – 24 %). Optionally the perforated panels should be equipped with a damper or an airflow control assembly.
- 1.4. ACCESSORIES



- A. Cut outs for power, voice & data service centres shall be provided in locations as detailed on the contract drawings.
- B. Provide manufacturer's standard steps, ramps, fascia plate, perimeter support, and grommets where indicated on the contract drawings.
- C. Provide spare floor panels and understructure systems for each type used in the project for maintenance stock. Deliver to project in manufacturer's standard packaging clearly marked with the contents. Quantity of Maintenance stock TBA.
- D. Provide panel-lifting devices. Quantity TBA.
- E. When applicable provide manufacturer's standard underfloor air systems components (including, grilles, diffusers, perforated floor panels and a 2-component concrete sealing paint) where indicated on the contract drawings.

#### 1.5. FINISHES

- 1. Finish the surface of floor panels with floor covering material as indicated on the drawings, Schedule of Finishes. Where floor coverings are to be provided by the access floor manufacturer, the type, colour and pattern shall be selected from manufacturer's standard. All storage and installation areas furnished with laminated floor panels must be maintained at ambient temperature between 15° to 25° C and at a relative humidity level between 40% to 65% and shall remain within these ranges through installation and occupancy.
- 2. High-pressure laminate (HPL) floor coverings shall meet requirements of EN 438-2.6 and EN 13329 Annex E with regards to the resistance of abrasion. The high-pressure laminate floor covering shall be antistatic in accordance to NFPA 99 and shall have a thickness of 0.9 mm.
- 3. Vinyl, Rubber or Linoleum floor coverings shall be homogenous and suitable for using on an access floor panel.
- 4. Coverings should be antistatic. Additionally the resistance to earth (surface to ground resistance) acc. to DIN EN 1081 shall be  $< 1 \times 10^9 \Omega$  if necessary.

#### 1.6. FABRICATION TOLERANCES

- A. Floor panel thickness at corners:  $\pm 0.3$  mm B.
- B. Floor panel straightness of the surface:  $\pm 0.3$  mm C.
- C. Floor panel width or length of required size:  $\pm 0.2$  mm D.
- D. Floor panel squareness tolerance:  $\pm 0.4$  mm
- E. Specifications in accordance to DIN EN 12825 certified by relevant quality assurance documents e. g. internal quality control documents according to ISO certification ISO 9001ff.

#### 3.7.10.3 PART 3 – EXECUTION

##### 1.1. PREPARATION

- A. Examine structural subfloor for unevenness, irregularities and dampness that would affect the quality and execution of the work. Do not proceed with installation until structural floor surfaces are level, clean, and dry as completed by others.



- B. Concrete sealers, if used, shall be identified and proven to be compatible with pedestal adhesive. Verify that adhesive achieves bond to slab before commencing work.
- C. Verify dimensions on contract drawings, including level of interfaces including abutting floor, ledges and doorsills.
- D. The General Contractor shall provide clear access, dry subfloor area free of construction debris and other trades throughout installation of access floor system. Area to receive access floor shall be enclosed and maintained at a temperature range of 15° to 25° C and a relative humidity range of 45 % to 65 %. All laminated floor panels shall be stored and maintained in this environment upon delivery to storage sites. Bare access floor panels must be stored in this environment at least 24 hours before installation begins.

#### **1.2. INSTALLATION**

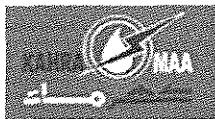
- A. Pedestal locations shall be established from approved shop drawings so that mechanical and electrical work can be installed without interfering with pedestal installation.
- B. Installation of access floor shall be coordinated with other trades to maintain the integrity of the installed system. All traffic on access floor shall be controlled by access floor installer. No traffic but that of access floor installers shall be permitted on any floor area for 24 hours to allow the pedestal adhesive to set. Access floor panels shall not be removed by other trades before acceptance.
- C. Floor system and accessories shall be installed under the supervision of the manufacturer's authorized representative and according to manufacturer's recommendations.
- D. No dust or debris producing operations by other trades shall be allowed in areas where access floor is being installed to ensure proper bonding of pedestals to subfloor.
- E. Access floor installer shall keep the subfloor broom clean as installation progresses.
- F. Partially complete floors shall be braced against shifting to maintain the integrity of the installed system where required.
- G. Additional pedestals as needed shall support panels where floor is disrupted by columns, walls, and cut-outs.
- H. Understructure shall be aligned such that all uncut panels are interchangeable and fit snugly but do not bind when placed in alternate positions.
- I. Finished floor shall be level, not varying more than 2.0 mm in 0.1m or 4.0 mm in 1.0 m or 12.0 mm in 10.0 m in accordance to DIN 18202.
- J. Acceptance: General contractor shall accept floor in whole or in part prior to allowing use by other trades.

#### **3.7.11 SECTION 09 90 00 – PAINTS AND COATINGS**

##### **3.7.11.1 PART 1 – GENERAL**

###### **1.1. SECTION INCLUDES**

- A. Painting or finishing of interior surfaces exposed to view;
  - 1. Of surfaces indicated on Drawings, Schedule of Finishes.



2. Of wood and metal in unfinished areas, except that factory applied finish coatings specified in other sections, stainless steel surfaces and metal surfaces of mechanical and electrical installations in service rooms require painting by this section.
- B. Painting of exterior metal surfaces exposed to view, except that factory applied finish coatings specified in other sections and stainless steel surfaces require painting by this section.
- C. Additionally, painting and finishing as indicated on Drawings, listed in finish Formula Schedule of this section, and as specified herein.
- D. Painting and finishing of pipe work as specified herein.
- E. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
- F. Do Not Paint or Finish the Following Items:
  1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
  2. Items indicated to receive other finishes.
  3. Items indicated to remain unfinished.
  4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
  5. Floors, unless specifically so indicated.
  6. Glass.
  7. Concealed pipes, ducts, and conduits.

#### 1.2. RELATED REQUIREMENTS

##### A. Related Requirements:

1. Civil & Structural Specifications - Cast-in-Place Concrete.
2. Section 042000 - Unit Masonry Assemblies.
3. Section 081113 – Hollow Core Metal Doors and Frames.
4. Section 081416 - Flush Wood Doors.
5. Section 092400 - Portland Cement Plaster.

#### 1.3. REFERENCE STANDARDS

##### 1. Reference Standards:

1. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
2. ASTM D523 - 89, Standard Test Method for Specular Gloss.
3. BS 3900, Methods of test for paint.
4. BS EN 1436, Road marking materials. Road marking performance for road users
5. BS EN 1871, Road marking materials. Physical properties.

#### 1.4. SUBMITTALS

##### A. See Section 013000 - Administrative Requirements, for submittal procedures.

##### B. Samples.

1. Submit 300mm x 300mm samples labelled to indicate finish, formula, colour name, number, sheen and gloss units of:
  - a. Each specified colour in each specified finish coat material.



- b. Each stained wood finish on specified wood species.
- C. Affidavits. Submit affidavits from manufacturer to certify that materials supplied for the Works meet specification requirements, that each is the "top line" material produced by the manufacturer and that he approves of their use for each proposed application.
- D. List of Materials. Before ordering materials submit a list of those materials proposed for use on Project for approval.
  - 1. for each material give;
    - a. Manufacturer.
    - b. Descriptive nomenclature that will appear on labels.
    - c. Qualities of formulation and performance, including, but not limited to;
      - 1) Basic components such as pigment, vehicle, drier, filler, etc.
      - 2) Brushing consistency, spread rate and flow.
      - 3) Wet edge and drying times.
      - 4) Flash point and combustibility.
      - 5) Hiding power and wet and dry film thickness.
      - 6) Compatibility with substrate.
      - 7) Alkali resistance where applied to cementitious substrates.
      - 8) Resistance to salt in atmosphere.
      - 9) Light fastness when exposed to artificial light surfaces.
  - 2. Do not order disapproved materials for project.
- 1.5. **QUALITY ASSURANCE**
  - 1. Manufacturer Qualifications. Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.
  - 2. Perform painting and finishing specified in this section only by a firm who has adequate equipment and skilled tradesmen to perform work expeditiously.
- 1.6. **MOCK-UP**
  - A. See Section 01400 - Quality Requirements, for general requirements for mock-up.
  - B. Completely finish complete wall and ceiling area as directed by Engineer for each finishing system, including typical door and similar installations to be painted or finished within the area, to test application procedures and coverage, colour, texture and gloss of finish materials.
  - C. Additionally, prepare representative mock-ups where directed on metal and wood surfaces that are not a part of the wall or ceiling areas.
- 1.7. **DELIVERY, STORAGE, AND HANDLING**
  - A. Deliver products to site in sealed and labelled containers, inspect to verify acceptability.
  - B. Store only acceptable project materials at site and in an area specifically set aside for purpose that is locked, ventilated, maintained at a temperature under maximum recommended by manufacturer and protected from direct rays of sun.
  - C. Ensure that health and fire regulations are complied with in storage area. Provide carbon dioxide fire extinguishers of 9 kg minimum capacity in each storage area while materials are stored in these areas.



- D. Container Label. Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, clean-up requirements, colour designation and instructions for mixing and reducing.

**1.8. FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Follow recommendations of the supplier of the products.
- D. Environmental conditions shall include, but shall not be limited to, ambient temperature, humidity, moisture in the air on the products and surfaces with which they are in contact, moisture content and temperature other products and materials with which they are in contact.
- E. Do not apply finishes when dust is being raised.
- F. Do not apply finishes on porous surfaces such as plaster, gypsum board, masonry and similar materials that contain over 12% moisture.
- G. Do not finish wood surfaces that contain over 15% moisture.
- H. Ensure that all areas in which paint is applied are well ventilated and broom clean.

**1.9. EXTRA MATERIALS**

- A. See Section 016000 - Product Requirements, for additional provisions.
- B. Deliver to Client on completion of painting and finishing and as he directs, sealed containers of each finish painting material applied and in each colour. Label each container as for original, including mixing formula. Provide 1L of extra stock when less than 50L are used for project, 4L of extra stock when 50 to 200L are used and 8L of extra stock when over 200L are used.
- C. Label each container with colour in addition to the manufacturer's label.

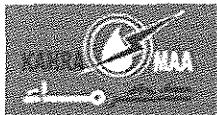
**3.7.11.2 PART 2 PRODUCTS**

**1.1. MATERIALS**

- A. Products of the manufacturers mentioned in the Drawings, Schedule of Finishes are acceptable provided that in each case they are approved on basis of formulation and performance qualities, and of samples submitted.
- B. Only "top line" products produced by their manufacturers on a production basis are acceptable. Materials, such as oils, shellacs, putties, thinners and other materials required for specified finishes shall be of the best quality produced or recommended by the manufacturer approved for supply of finish materials in which they are incorporated.
- C. Use only exterior grade materials for exterior surfaces

**1.2. MIXING**

- A. Paints shall be supplied ready-mixed unless otherwise specified. Do not incorporate adulterants.



- B. Pigment shall be well ground to form a soft paste in the vehicle during its storage life. Paddle mixing at job shall evenly disperse paste throughout mixture to ensure paint of smooth flowing, easy brushing, and consistency.
- C. Mix paints only in mixing pails placed on suitably sized, non-ferrous or oxide resistant metal pans.

#### **1.3. PAINTS AND COATINGS - GENERAL**

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
  - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
  - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
  - 1. Provide coatings that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D-National Volatile Organic Compound Emission Standards for Architectural Coatings.
  - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colourants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

#### **3.7.11.3 PART 3 - EXECUTION**

##### **1.1. EXAMINATION**

- A. Verify that specified environmental conditions are ensured before commencing painting and finishing preparation and applications.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Measure moisture content of surfaces using an electronic moisture meter.
- E. Test surfaces of materials containing lime for acid-alkali balance
- F. Maintain at site at all times until applications are completed a moisture meter, hygrometer and thermometer to verify surface and environmental conditions.
- G. Defective painting and finishing applications resulting from failure to properly test surfaces and/or from application to unsatisfactory surfaces will be considered the responsibility of this section.

##### **1.2. PREPARATION**

- A. Clean surfaces thoroughly and correct defects prior to coating application.



- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. General.
  - 1. Vacuum clean interior areas immediately before finishing work commences.
  - 2. Remove from surfaces grease, oil, dirt, dust, ridges and other soil and materials that would adversely affect the adhesion or appearance of finish coatings.
  - 3. Remove rust from damaged surfaces primed by other sections and re-prime.
  - 4. Touch up damaged prime coats on shop primed metals with same priming material. Feather out edges of shop coat and smooth repair coat into shop coat surfaces.
  - 5. Finish, patch and smooth surfaces to remove cracks, holes, ridges and similar blemishes.
  - 6. Neutralize highly alkaline surfaces with a neutralizing wash of 4% solution of zinc sulphate. Substitute 4% solution of tetra potassium pyrophosphate for surfaces to receive latex paints. Brush off residue before painting.
  - 7. Scrub mildewed surfaces with a solution of tri-sodium phosphate, bleach with a solution of one part sodium hypochlorite (Javex) to three parts water, and rinse with clear water.
- D. Metal Surfaces.
  - 1. Unprimed Steel. Remove weld flux and scale with scrapers, wire brushes, wire power wheels, sandblasting, chipping, or grinding as may be required. Finish surfaces smooth, and remove alkali contamination from weld flux with phosphoric acid solution. Wash with solvent.
  - 2. Primed Steel. Before touch-up of prime paint, smooth out surface irregularities, clean weld joints, bolts, nuts and damaged areas with phosphoric acid solution, and wash with solvent.
  - 3. Galvanized Steel. Wash thoroughly with mineral spirits, and wipe dry with completely clean cloths. Ensure that all passivation treatments applied by manufacturing or fabrication processes have been removed. Apply galvanized steel primer.
  - 4. Aluminium, Mill Finish, Painted. Clean surfaces by steam, high pressure water, or mineral spirits wash. Immediately before painting, treat with acid etch, or apply etching type primer.
  - 5. Copper, Painted. Clean surfaces by steam, high pressure water, or mineral spirits or mild phosphoric acid cleaner. Apply etch type primer while surface is freshly cleaned.
- E. Cementitious Substrates.
  - 1. Fill minor holes and cracks with Portland cement mix. Match patches to texture of adjacent surfaces.
  - 2. Remove dirt, scale, loose mortar, and similar foreign matter by brushing.
  - 3. Remove oil and grease with a washing with tri-sodium phosphate solution followed by a through rinsing with water.
  - 4. Remove efflorescence by dry brushing or, if required, by washing with dilute muriatic solution of one part commercial muriatic acid to 20 parts water, followed by a complete rinse by drenching with clear water.
- F. Wood.
  - 1. Sand finish surfaces smooth with No. 00 sandpaper.
  - 2. Clean soiled surfaces with an alcohol wash.
  - 3. Wipe off dust and other loose dirt, or vacuum clean, before application of coatings.



4. Seal knots, pitch and sapwood with two coats of orange shellac where painted, or an application of special sealer. Use only clear sealer that is compatible with transparent finish.
  5. After prime coat is dry and sanded, fill nail and screw holes and cracks with wood filler, or with putty. Colour fillers to match wood or stain if surfaces are given clear final coatings. Smooth, sand and prime fillers when set.
- G. Gypsum Board.
1. Fill minor holes and depressions, caused by accidental damage, with drywall joint compound and sand smooth when it is set, taking care not to raise nap of paper cover.
- H. Gypsum Plaster.
1. Fill narrow shallow cracks, small holes, scratches and similar damage with spackling compound. Rake out deep cracks and holes, soak with water and fill with successive thin layers of patching plaster or spackling compound.
  2. Sand patched surfaces very lightly to smooth out level with adjoining surfaces.
  3. Neutralize highly alkaline surfaces.
- I. Protection.
1. Cover or mask surfaces adjacent to those receiving treatment and finishing to protect materials and surfaces installed by other sections from damage and soil. Mask instruction and specification plates attached to equipment being painted.
  2. Take particular care in storage and mixing areas that floors are protected by tarpaulins and metal pans.
  3. Place cloths and other disposable finishing materials, that are a fire hazard, in closed metal containers containing water and remove from building every night.
  4. Ensure that the appropriate trades remove from finished surfaces, store and reinstall after finishing is completed finish hardware, switch and receptacle plates, escutcheons, luminaire frames and similar items.
  5. Porous materials from which soil from finish materials cannot be completely removed shall be replaced by this section.
  6. Post "No Smoking" signs and ensure that spark-proof electrical equipment is used in areas where inflammable painting materials are being applied.
  7. Post "Wet Paint" signs throughout freshly finished areas and remove when finishes are dry.

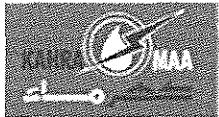
### 1.3. APPLICATION

A. General.

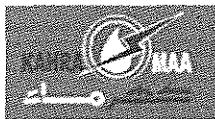
1. Perform painting and finishing specified in this section under supervision of experienced foremen, with clean equipment designed for purpose used, and under directions and specific recommendations of manufacturers whose materials are used.
2. Before commencing applications, arrange for a site meeting at which conditions of surfaces and possible adaptations to suit and use of materials and application procedures shall be discussed between Contractor, Painting Sub-contractor and Engineer.



3. Consult with Engineer before proceeding with application of finishes to surfaces for which a formula is not given in specification.
  4. Do not paint caulked joints.
  5. Remove spatters of finish materials from adjacent surfaces, including glass, before they set up and by methods not harmful to the surfaces.
- B. Priming and Backpriming.
1. Verify, by review of other sections of the specification, the extent of surfaces primed by other sections. Priming of unprimed surfaces shall be provided by this section.
  2. Prime paint rough carpentry surfaces specified in section 06100 where not concealed by other construction.
  3. Backprime woodwork, fitments and similar wood installations as soon as it is delivered and before it is installed. Use enamel undercoater for surfaces to receive paint or enamel finishes. Prevent primer from running over faces.
  4. Backprime wood receiving clear finishes with gloss varnish reduced 25% by mineral spirits.
  5. Prime tops and bottoms of painted wood doors with enamel undercoat.
  6. Prime tops and bottoms of clear finished doors with gloss varnish. When doors are stained apply varnish after staining.
  7. Remove doors to prime and finish.
  8. Prime alkaline surfaces with alkali resistant primer.
  9. Brush out and force primers into grain of wood and into crevices, cracks and joints in all materials.
- C. Painting.
1. Apply paint by brush or rollers. Spray paint only when requested or approved, and in approved areas. Discontinue spraying if directed because of inadequate coverage, over spray, paint fog drift, or disturbance to construction operations.
  2. Use only brushes for enamels and varnishes, and for painting wood.
  3. Specified formulas are intended to completed cover surfaces. If it is considered that coverage is inadequate, do not commence application without direction. Otherwise, apply as many coats as necessary to ensure completely satisfactory cover.
  4. Use only unadulterated paint. Thin paint as specified by manufacturer.
  5. Touch up visible suction spots on dried primer and ensure that they are sealed before application of second coat. Repeat on second coat if still visible.
  6. Do not paint metal access and electrical panels when they are closed. Paint when open and leave open until dry.
- D. Pigmented Stain Finish.
1. Stain wood to obtain a uniformity of colour over entire wood surfaces as demonstrated to Engineer for his approval. Ensure that colour variations are matched to the darkest component of the installation.
- E. Finishing Methods.



1. Apply finishing materials at proper consistency, free from brush marks, sags, crawls, streaks, runs, laps, skips, voids, pinholes, missed areas, and other perceptible defects, and with even colour, sheen and texture.
  2. Apply finishing materials to ensure full coverage, and at a rate not to exceed that recommended by the manufacturer for the applicable surface.
  3. Make clean true junctions with no overlap between adjoining applications of finish coatings.
  4. Leave all parts of mouldings and ornaments clean and true to details with no undue amount of coating in corners and depressions.
  5. Use materials of a single manufacturer in each coating system.
  6. If evidence is inconclusive that a specified coat has been applied, apply a full coat to the areas concerned.
  7. Obtain approval of each coat of finishing material before proceeding with next coat. Coats not approved shall be redone, as no credit will be given for those not approved.
  8. Apply each coat only after preceding coat is dry and hard, or as otherwise directed by material manufacturer.
  9. Sand surfaces lightly with No. 00 sandpaper between coats on wood and metal.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- 1.4. CLEANING
- A. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.
- 1.5. SCHEDULE - SURFACES TO BE PAINTED AND FINISHED
- A. General.
    1. This section shall include painting and/or finishing of all surfaces exposed to view that have been installed with no final finish provided by the installer, unless otherwise specified.
    2. Finish interior surfaces, including objects within each area unless otherwise excluded, as indicated on finish schedule.
    3. Wall surfaces partially finished with other finish materials shall have remainder of surfaces finished as for surrounding surfaces.
    4. Finish equipment, panels, fitments, services, structure, attachments, and accessories, prime coated hardware, or similar appurtenances on or near finished surfaces to match finish of the surface.
    5. Finish edges and tops of trim, projecting ledges, fitments, cupboards, and similar surfaces to match adjacent surfaces, whether or not they are above or beyond sight lines.
    6. Finish interiors of alcoves, recesses, closets, cupboards, fitments, and similar spaces to match adjacent surfaces unless otherwise indicated.
    7. Finish surfaces visible through grilles, grille cloth, perforated metals, screening, convector covers, louvers, linear metal ceilings, and other openings, including inside of ductwork, with two coats of matte black paint. If it is the intention that finished surfaces be seen behind the elements listed



above, finish the surfaces to match adjoining surfaces. Finish entire ceiling space and equipment & framing of auditorium to matt black to conceal all services and systems.

8. Finish exposed wood and exposed ferrous metals, whether primed or galvanized or not, on surfaces that are indicated as unfinished except as specified in paragraph .5 following.
  9. Paint exposed metal housings of weatherstripping and door seals and door closers to match surface to which they are attached and which are painted or finished by this section.
  10. Ensure that colour coded services are properly identified. Finish entire ceiling space in rooms designated with open cell ceiling to paint colour to the selection of the Engineer.
- B. Doors.
1. Finish wood edges of doors and edges of metal doors exposed to view with the same number of coats of material and colour as adjoining surface finishes.
- C. Painting of Piping and Conduit
1. Identification of piping and conduit as specified.
- D. Include finishing of the following surfaces by this section.
1. Interior ferrous metal hardware, fasteners and accessories.
  2. Interior galvanized hardware, fasteners and accessories.
  3. Exterior ferrous metal hardware, fasteners and accessories.
  4. Exterior galvanized hardware, fasteners and accessories.
  5. Access Doors
  6. Prime painted louvers, grilles, and diffusers at interior. Prime painted louvres, grilles, and diffusers at exterior.
  7. Prime painted electrical panel doors and frames.
  8. Pipework and conduit in service rooms and where exposed to view.

#### 1.6. FINISH FORMULA SCHEDULE

A. General.

1. This section shall include painting; staining and/or finishing of all surfaces exposed to view that have been installed with no final finish provided by the manufacturer or supplier, unless otherwise specified.
2. Finish interior surfaces, including objects within each area unless otherwise excluded, as indicated on Finish Schedule.
3. Wall surfaces partially finished with other finish materials shall have remainder of surfaces finished as for surrounding surfaces.



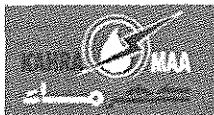
4. Finish equipment, panels, fitments, services, structure, attachments, and accessories, prime coated hardware, or similar appurtenances on or near finished surfaces to match finish of the surface.
- B. Surfaces that Require No Finishing.
1. Painting or finishing of the following surfaces is not included in this section,
    - a. Plastics, metals with porcelain enamel, baked enamel or plated finishes, stainless steel, sound absorbent surfaces, vitreous, glazed ceramic or plastic facings factory finished surfaces as specified in other sections, control panels, circuit breakers, switches, receptacles or similar electrical components, or name and specification plates on equipment, ducts, pipes and conduit in service rooms where concealed from view.
- C. Gloss.
1. Gloss value shall be determined in accordance with ASTM D523 Tentative Method of Test for 60 deg. specular gloss.
  2. Gloss values for terminology specified shall be;
    - a. less than 10 for matt,
    - b. 10 to 35 for eggshell,
    - c. 35 to 60 for semi-gloss,
    - d. 60 to 80 for gloss,
    - e. 80 to 90 for high gloss.
  3. Gloss requirements will be indicated on schedule provided by Engineer after award of Contract.
- D. Colours.
1. Colours of paints, including shades of stains, shall be applied to match approved samples.
  2. Colour requirements will be indicated on schedule provided by the Engineer after award and during the currency of Contract.
- 1.7. FORMULA SCHEDULES
- A. EXTERNAL MASONRY WALL PAINT SYSTEM: FULL EPOXY SYSTEM.
1. Manufacturer: Jotun - Full Epoxy Texotile System or equal approved.
  2. Surface(s): Concrete/ Rendered Blockwork.
  3. Preparation: as clause 400 and to manufacturer's recommendation.
  4. Initial coat(s): to manufacturer's recommendation.
    - a. 1- Coat. Panguard HB (Epoxy Primer) or equal approved.
    - b. 1- Coat. Panguard Texo (Epoxy Texture) or equal approved.
  5. Finishing coat(s): to manufacturer's recommendation.
    - a. 2- Coats. Durathane (2 pack Polyurethane Topcoat) or equal approved.



6. Location(s): All External Walls.
- B. ACRYLIC EMULSION WALL PAINT SYSTEM.
  1. Manufacturer: Jotun - or equal approved.
  2. Surface(s): plaster/render/pre-cast concrete/insitu concrete/drywall partition.
  3. Preparation: to manufacturer's requirements, as clause 400.
  4. Initial coat(s):
    - a. 1 no. Coat of Jotun PVA Primer, copolymer based alkali resistant sealer.
    - b. 2 nos. Coats of Jotun Stucco, PVA copolymer based putty.
  5. Finishing coat(s):
    - a. 2 nos. Coats Jotun Fenomastic Silk, acrylic copolymer based emulsion paint.
  6. Colour: to Engineer approval.
- C. MATT ALKYD ENAMEL PAINT SYSTEM
  1. Manufacturer: Jotun - or equal approved.
  2. Surface(s): Fair-Faced Concrete Block and Columns.
  3. Preparation: to manufacturer's requirements, as clause 400.
  4. Initial coat(s):
    - a. 1 no. Coat of Jotun Arylic Emulsion Primer, acrylic based alkali resistant primer/sealer.
    - b. 2 nos. Coats of Jotun Stucco, PVA copolymer based putty.
  5. Finishing coat(s):
    - a. 2 nos. Coats Jotun Bengalac Flat.
  6. Colour: Allow standard colour range to Engineer approval
- D. WORKSHOP PAINT SYSTEM
  1. Manufacturer: Jotun - or equal approved.
- E. EPOXY PAINT - UP TO 2200 mm ABOVE FFL (to match Door Height)
  1. Manufacturer: Jotun - or equal approved.
  2. Surface(s): Plaster/render/pre-cast concrete/insitu concrete. Fill blow holes or pores of concrete with Renderoc FC and Nitoprime DG if necessary.
  3. Preparation: to manufacturer's requirements, as clause 400.
  4. Initial coat(s): to manufacturer's recommendation
    - a. 1 no. Coat of Penguard Sealer
    - b. 1 no. Coat of Penguard HB
  5. Finishing coat(s): to manufacturer's recommendation.
    - a. 2 nos. of Penguard Topcoat
  6. Colour: to Engineer approval



- F. CONCRETE BLOCKWORK AND CONCRETE SEALER PAINT SYSTEM.
1. Manufacturer: Jotun - or equal approved.
  2. Reference: Penguard Clear Sealer
  3. Surface(s): Concrete blockwork, concrete stair and slab soffits.
  4. Preparation: as clause 400.
  5. Initial coat(s): 1 coat
  6. Finishing coat(s): 1 coat .
- G. ANTI CARBONATION - EMULSION
1. Manufacturer: Jotun - or equal approved.
  2. Surface(s): Plaster/render/pre-cast concrete/insitu concrete.
  3. Preparation: to manufacturer's requirements, as clause 400.
  4. Initial coat(s): to manufacturer's recommendation
    - a. 1 no. Coat of Jotun Arylic Emulsion Primer, acrylic based alkali resistant primer/sealer.
    - b. 2 nos. Coats of Jotun Stucco, PVA copolymer based putty.
  5. Finishing coat(s): to manufacturer's recommendation.
    - a. 2 nos. Coats Jotun Gardex Gloss, lead free alkyd paint with high gloss finish.
  6. Colour: to Engineer approval
- H. ZINCOPHOSPHATE PROTECTIVE PAINT TO EXTERNAL STEELWORK AND EXPOSED METAL SERVICES.
1. Manufacturer: Alchem - G058 Oasis steel matt or equal approved.
  2. Surface(s): Steel.
  3. Preparation: as clause 400.
  4. Initial coat(s):
    - a. 1 no. Coat Oasis Zinc Phosphate .
    - b. 1 no. Coat Oasis Steel Undercoat.
  5. Finishing coat(s):
    - a. 2nos. Coat Oasis Steel Matt. Colour to Engineer approval.
- I. THERMOPLASTIC PAINT YELLOW/WHITE CAR PARK NUMERAL/LINES.
1. Manufacturer: to architect's approval.
  2. Surface(s): interlock paving/asphalt/epoxy resin coating-as per schedule.
  3. Preparation: to manufacturer's recommendation.
  4. Coat(s): Thermoplastic paint to car park numerals 300 mm high, and lines 100 mm wide as per drawings, applied as per manufacturer's recommendations and specifications.
- J. ALKYD GLOSS PAINT.
1. Manufacturer: Jotun - or equal approved.
  2. Location(s): Internal Timber Finishings.
  3. Surface(s): Timber Doors, Timber and MDF boards.
  4. Preparation: as clause 400.



5. Initial coat(s): 1 coat Gardex Flat
6. Finishing coat(s): 2 coats Gardex Gloss.

### **3.7.12 SECTION 09 96 00 - HIGH PERFORMANCE COATINGS**

#### **3.7.12.1 PART 1 - GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Provides wall base in all areas where floor sealing is required. The material used shall be similar to floor finish.
- B. Hardened and sealed concrete surfaces of work shop, mechanical rooms and storage rooms.

##### **1.2. RELATED REQUIREMENTS**

- A. Related Requirements:

1. Section 033000 - Cast in Place Concrete.

##### **1.3. REFERENCE STANDARDS**

- A. Related Standards:

1. ASTM E11, Specification for Wire-Cloth Sleeves for Testing Purposes.
2. ASTM C67, Method of Sampling and Testing Brick and Structural Clay Tile.
3. ASTM C126, Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick and Solid Masonry Units.
4. ASTM C109/C109M-02, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-in or (50mm) cube specimens).
5. ASTM C190, Test method for Tensile Strength of Hydraulic Cement Mortars.
6. ASTM D570, Test Method for Water Absorption of Plastics
7. ASTM D635, Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
8. ASTM D638, Test Method for Tensile Properties of Plastics.
9. ASTM D696, Test Method for Coefficient of Linear Thermal Expansion of Plastics.
10. ASTM D905, Test Method for Strength Properties of Adhesive Bonds in shear by Compression Loading.
11. ASTM D1044, Test Method for Resistance of Transparent Plastics to Surface Abrasion.
12. ASTM D1308, Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
13. ASTM C944, Abrasion Resistance for Concrete Surfaces.
14. BS 476, Fire Tests on Building Materials.
15. BS 1881, Testing Concrete.
16. BS 4551, Methods of Testing Mortars, Screeds and Plaster.
17. BS 12, OPC Cement Specification.
18. BS 6319, Testing of Resin and Polymer/Cement Compositions for Use in Construction.

##### **1.4. SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.



**1.5. QUALITY ASSURANCE**

- A. Qualifications. Provide floor sealing specified in this section only by sealer manufacturer and applicator who specialize in such installations and who are known to have been responsible for satisfactory applications similar to that specified during a period of at least the immediate past ten years. Applicator to be approved in writing by the manufacturer of the materials and products.

**1.6. DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store and handle packaged materials to prevent contamination and damage due to environmental and other causes.
- B. Ensure that health and fire regulations and other safety measures, specified by the manufacturer, are complied with in the storage area, during handling and application.
- C. Place cloths and other disposable sealing materials, that are a fire hazard, in closed metal containers and remove from building every night.

**1.7. FIELD CONDITIONS**

- A. Adapt techniques approved by the Engineer to ensure that storage, handling and execution methods suit environmental conditions that are encountered at the site and cause no damage to the products specified in this section or to the performance of these products in use.
- B. Follow recommendations of the supplier of the products.
- C. Environmental conditions shall include, but shall not be limited to, ambient temperature, humidity, moisture in the air and on the products and surfaces with which they are in contact, moisture content and temperature of the products and materials with which they are in contact.
- D. Apply sealer only in well ventilated, broom-clean areas when no dust is being raised. Erect suitable barriers during installation and curing. Post signs as required.
- E. Restrict traffic from area where coating is being applied or is curing.

**3.7.12.2 PART 2 – PRODUCTS**

**1.1. MATERIALS**

- A. Each material used in floor sealing and hardening shall be as recommended or manufactured by the manufacturer of the sealer.
- B. Concrete Floor Hardener (S/CONC)
  - 1. In areas designated as Sealed Concrete (S/CONC) in Room Finish Schedule.
  - 2. Non-yellowing, non-metallic monolithic surface hardening compound, to conform to specified requirements;
    - a. Compressive Strength of 70 N/mm<sup>2</sup> when tested in accordance with BS 1881.
    - b. Improve the abrasion rate of concrete 300% when measured in accordance with the requirements of ASTM C944.
    - c. Non-ferrous rust free aggregate containing the hardness value of not less than 7 (seven) on the MOHS original scale.
    - d. 100m high matching cove base.
    - e. Equivalent to WR meadows seal tight. Liquid hard chemical concrete hardener and sealer or Nitofloor Hard Top or Fosroc or Endura Mineral by FEB or approved equal.



- C. Heavy Duty Epoxy Resin Screed, chemical and abrasion resistant, 2 coat application.
  - 1. The epoxy resin screed shall cure to a minimum thickness of 6mm.
  - 2. Minimum compressive strength of 68 N/mm<sup>2</sup> when tested in accordance with BS 11881 Part 4, 1970, Clause 2.
  - 3. Minimum flexural strength of 15N/mm<sup>2</sup> when tested in accordance with BS 4551 Part 1, 1970.10.3
  - 4. Minimum tensile strength of 7.5 N/mm<sup>2</sup> when tested in accordance with BS 12 1958 app H.
  - 5. Abrasion resistance cycle 2.7 mg/cycle maximum (Paint Research Association, U.K. Taber Abrasion test wt loss)
  - 6. A minimum bond strength to concrete of 3 N/mm<sup>2</sup> i.e. greater than the typical cohesive strength of concrete (Escometer pull of test).
  - 7. The material shall cure to initial hardness in 16 hours with full cure in 6 days (30° C).
  - 8. Equivalent to BASF Mastertop 1205 EP Anti slip or Nitofloor TF5000 by Fosroc or Endura Lay by FEB or Sika Floor by Sika.
- D. Waterproofing with Sealed Concrete (WP on CONC).
  - 1. In areas designated as waterproofing with wearing surface on concrete (WP on CONC) in Room Finish Schedule, including Mechanical Rooms.
  - 2. Two component system consisting of;
    - a. High Performance Epoxy.
    - b. Concrete Floor Sealer.
  - 3. High Performance Epoxy - resin based floor coating and sealer. Overcoat to Sealed Concrete.
    - a. Applied in 2 No. coats to a total dry film thickness of 100 microns.
    - b. Volume solids (mixed material) 45%.
    - c. Specific gravity 1.2
    - d. Spread of flame (BS 476 pt7) Class 1.
    - e. The material shall cure to initial hardness in 18 hrs and to full cure in 15 days (at 35° C).
    - f. Equivalent to Nitofloor FC140 or Endurabate or Sika Floor 93
  - 4. Concrete Floor Sealer-non-metallic monolithic surface hardening compound. As per Part 2.01 B as above.
- E. Waterproofing and Wearing Surface (S/CONC - WP).
  - 1. In areas designated as waterproofing and wearing surface at floor and base (S/CONC WP), including garbage room and as indicated in Room Finish Schedule.
  - 2. Two component system consisting of;
    - a. High Performance Self-Smoothing Epoxy - floor topping.
    - 2) Applied 2 coats to a minimum 2mm.
    - 3) A minimum compressive strength of 50 N/mm<sup>2</sup> at 7 days when tested in accordance with BS 6319.
    - 4) A minimum tensile strength of 16 N/mm<sup>2</sup> when tested in accordance with BS 6319.
    - 5) A typical impact resistance of 4 kg/m.
    - 6) Equivalent to Nitofloor SL2000 or EnduraFloor EP Nonslip or Sika Floor 92 (+94 Primer).
  - b. Heavy Duty Epoxy Resin Screed as per Part 2.01 C above.

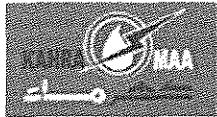


- F. Traffic Topping Anti-Skid (TT).
1. In areas designated as special traffic construction with gasoline resistant membrane (TT) including underground parking areas and driveways as indicated in Room Finish Schedule.
  2. Heavy duty, flow applied, light weight anti-skid surface dressing.
    - a. Total surface dressing thickness - 5 - 8mm.
    - b. Primer coverage - 3m<sup>2</sup>/kg.
    - c. Thickness - 4mm.
    - d. Coverage - 6kg/m<sup>2</sup>.
    - e. Pot life - 30 mins @20°C.
    - f. Specific gravity - 1.6.
    - g. Solvent content - zero (solvent free).
    - h. Cure time - foot traffic after 24 hrs.
      - 1) Vehicular traffic after 48 hrs.
    - i. Chemical resistance - petrol.
      - 1) Diesel.
      - 2) Hydraulic fluids class 1.
    - j. Resistance to flame spread - zero spread of flame. (BS 476 Part 7 clause 2)
    - k. Aggregate;
      - 1) Size - 0.4 to 1mm.
      - 2) Abrasion value - maximum 1.9.
      - 3) Impact value - maximum 8.0.
      - 4) Crushing value - maximum 8.2.
      - 5) Hardness, Mohs scale - maximum 9.0.
      - 6) 10% fines value - 565 KN.
    - l. Colours to be selected by the Engineer.
    - m. Turn up coating 150mm up the walls and columns.
    - n. Where the vehicular traffic coating is exposed to ultra violet light provide additional layer of ultra-violet light resisting top coating on the traffic deck, ramps, drive aisles and turning areas.
    - o. Equivalent to Nitofloor CICOL ET Slurry or Enduraguard EP on top Enduraguard or Sika floor 6516
- G. Dust proofer. Apply a clear sealer dust proofer compound over all power floated slab surfaces in the office tower.

### 3.7.12.3 PART 3 – EXECUTION

#### 1.1. EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- C. Test surfaces for moisture content to ensure that they are suitable for application as recommended by sealer manufacturer and those surfaces are satisfactory for sealing.



- D. Defective floor sealing resulting from application to unsatisfactory surfaces will be considered the responsibility of this section.

- E. Acid etches concrete surfacing with phosphoric acid solution or prepare mechanically where required.

#### 1.2. PREPARATION

- A. Following his acceptance of surface, sealer applicator shall be responsible for surface preparation which is not specified as the responsibility of other sections.
- B. Clean, etch, prime and otherwise prepare surfaces, as required and apply sealer, special flooring and coatings to meet specified requirements of sealer manufacturer.
- C. Cover or mask surfaces adjacent to those receiving applications to protect materials of others and property from damage and soil.
- D. Materials and surfaces damaged or soiled, or both, by applications and from which soil or damage cannot be completely eradicated, shall be replaced by this section.
- E. Erect barriers to prevent the entry and presence of personnel not performing floor applications during application of materials and until it have cured sufficiently to bear traffic.
- F. Apply coatings in strict accordance with manufacturer's instructions.

#### 1.3. COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions, to thicknesses specified.
- B. For base skirting where described in schedules apply manufacturers approved details or recommendations.
- C. Apply sealer, wipe off surplus and buff to produce smooth evenly covered surfaces free of lint, dust and other foreign materials, bubbles, brush marks, stains and similar defects that are detrimental to performance.
- D. Apply sealant in correct sequence of operations with other trades around.
- E. Project sealant during curing and after from damage by other materials and traffic.
- F. Where sealant or waterproofing carries a water repellent junction eg. To allow for waterproof testing to be carried out is incumbent upon this programme.

**END OF SECTION 09 96 00**

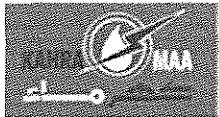
### **3.8 DIVISION 10 SPECIALTIES**

#### **3.8.1 SECTION 10 14 00 – SIGNAGE**

##### **3.8.1.1 PART 1 – GENERAL**

###### **1.1 DESCRIPTION**

- A. This section specifies interior signage for room numbers, directional signs, code required signs, telephone identification signs and temporary interior signs.



- B. This section also specifies exterior medical center identification signs, building identification signs, parking and traffic signs.

- C. Installation of Government furnished dedication plaque and VA seal.

#### **1.2 RELATED WORK**

- A. Electrical: Related Electrical Specification Sections.

- B. Lighted EXIT signs for egress purposes are specified under Division 26, ELECTRICAL.

- C. SCHEDULE FOR FINISHES & Signage Drawings.

#### **1.3 MANUFACTURER'S QUALIFICATIONS**

- A. Sign manufacturer shall provide evidence that they regularly and presently manufactures signs similar to those specified in this section as one of their principal products.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

- B. Samples: Sign panels and frames, with letters and symbols, each type. Submit 2 sets. One set of samples will be retained by Resident Engineer, other returned to Contractor.

1. Sign Panel, 200 mm x 250 mm (8 inches x 10 inches), with letters.

2. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches). Show anticipated range of color and texture.

3. Sample of typeface, arrow and symbols in a typical full size layout.

- C. Manufacturer's Literature:

1. Showing the methods and procedures proposed for the concealed anchorage of the signage system to each surface type.

2. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions.

- D. Samples: Sign location plan, showing location, type and total number of signs required.

- E. Shop Drawings: Scaled for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.

- F. Full size layout patterns for dimensional letters.

#### **1.5 DELIVERY AND STORAGE**

- A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon. Protect materials from damage.

- B. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.

- C. Deliver signs only when the site and mounting services are ready for installation work to proceed.

- D. Store products in dry condition inside enclosed facilities.

#### **1.6 APPLICABLE PUBLICATIONS**

- D. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

- E. American Society for Testing and Materials (ASTM):

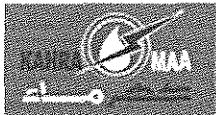
1. B209-07 Aluminum and Aluminum-Alloy Sheet and Plate

2. B221-08 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and tubes.

#### **1.7 MINIMUM SIGN REQUIREMENTS**



- A. Permanent Rooms and Spaces:
    - 1. Tactile and Braille Characters, raised minimum 0.793 mm (1/32 in). Characters shall be accompanied by Grade 2 Braille.
    - 2. Type Styles: Characters shall be uppercase, Helvetica Medium, Helvetica Medium Condensed and Helvetica Regular.
    - 3. Character Height: Minimum 16 mm (5/8 in) high, Maximum 50 mm (2 in).
    - 4. Symbols (Pictograms): Equivalent written description shall be placed directly below symbol, outside of symbol's background field. Border dimensions of symbol background shall be minimum 150 mm (6 in) high.
    - 5. Finish and Contrast: Characters and background shall be eggshell, matte or other non-glare finish with adequate contrast with background.
    - 6. Mounting Location and Height: As shown. Mounted on wall adjacent to the latch side of the door and to avoid door swing and protruding objects.
  - B. Overhead Signs:
    - 1. Type Styles: As shown. Characters shall have a width-to-height ratio between 3:5 and 1:1. Characters shall have a stroke width-to-height ratio of between 1:5 and 1:10.
    - 2. Character Height: minimum 75 mm (3 in) high for overhead signs. As shown, for directional signs.
    - 3. Finish and Contrast: Same as for signs of permanent rooms and spaces.
    - 4. Mounting Location and Height: As shown.
  - 1.8 COLORS AND FINISHES:
  - A. SCHEDULE FOR FINISHES & Signage Drawings.
- 3.8.1.2 PART 2 – PRODUCTS
- 1.1. GENERAL
    - A. Signs of type, size and design shown on the drawings and as specified.
    - B. Signs complete with lettering, framing and related components for a complete installation.
    - C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
    - D. Do not scale drawings for dimensions. Contractor to verify and be responsible for all dimensions and conditions shown by these drawings. Resident Engineer to be notified of any discrepancy in drawing, in field directions or conditions, and/or of any changes required for all such construction details.
    - E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. The Contractor shall further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.
  - 1.2. PRODUCTS
    - A. Aluminum:
      - 1. Sheet and Plate: ASTM B209.



2. Extrusions and Tubing: ASTM B221.
  - B. Cast Acrylic Sheet: MIL-PRF-8184F; Type II, class 1, Water white non-glare optically clear. Matt finish water white clear acrylic shall not be acceptable.
  - C. Polycarbonate: Mil-P-46144C; Type I, class 1.
  - D. Vinyl: 0.1 mm thick machine cut, having a pressure sensitive adhesive and integral colors.
  - E. Electrical Signs:
    1. General: Furnish and install all lighting, electrical components, fixtures and lamps ready for use in accordance with the sign type drawings, details and specifications.
    2. Refer to Electrical Specifications Section, Division 26, ELECTRICAL, to verify line voltages for sign locations that require electrical signs.
    3. Quality Control: Installed electrical components and sign installations are to bear the label and certification of Underwriter's Laboratories, Inc., and are to comply with National Electrical Code as well as applicable federal, state and local codes for installation techniques, fabrication methods and general product safety.
    4. Ballast and Lighting Fixtures: See Electrical Specifications.
  - F. Concrete Post Footings: See Section 03 30 53, MISCELLANEOUS CAST-IN-PLACE CONCRETE, Cast-in-place Concrete.
  - G. Steel: See Section 05 12 00, STRUCTURAL STEEL FRAMING.
- 1.3. SIGN STANDARDS**
- A. Topography:
    1. Type Style: Helvetica Medium and Helvetica Medium Condensed. Initial caps or all caps as indicated in Sign Message Schedule.
    2. Arrow: See graphic standards in drawings.
    3. Letter spacing: See graphic standards on drawings.
    4. Letter spacing: See graphic standards on drawings.
    5. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only; final text for signs is listed in Sign Message Schedule.
  - B. Project Colors and Finishes: SCHEDULE FOR FINISHES & Signage Drawings.
- 1.4. SIGN TYPES**
- A. General:
    1. The interior sign system is comprised of sign types families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family.
    2. The exterior sign system shall be comprised of sign types families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family.
    3. As per Signage Drawings



### 1.5. FABRICATION

- A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
- B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.
- D. Contact surfaces of connected members be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth surfaces.
- G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
- I. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Edge joints tightly mitered to give appearance of solid material.
- J. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
- K. Movable parts, including hardware, are to be cleaned and adjusted to operate as designed without binding or deformation of members. Doors and covers centered in opening or frame. All contact surfaces fit tight and even without forcing or warping components.
- L. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
- M. No signs are to be manufactured until final sign message schedule and location review has been completed by the Resident Engineer & forwarded to contractor.

#### 3.8.1.3 PART 3 - EXECUTION

##### 1.1. INSTALLATION

- A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.



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- B. Mount signs in proper alignment, level and plumb according to the sign location plan and the dimensions given on elevation and sign location drawings. Where otherwise not dimensioned, signs shall be installed where best suited to provide a consistent appearance throughout the project. When exact position, angle, height or location is in doubt, contact Resident Engineer for clarification.
- C. Contractor shall be responsible for all signs that are damaged, lost or stolen while materials are on the job site and up until the completion and final acceptance of the job.
- D. Remove or correct signs or installation work Resident Engineer determines as unsafe or as an unsafe condition.
- E. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.
- F. Locate signs as shown on the Sign Location Plans.
- G. Certain signs may be installed on glass. A blank glass back up is required to be placed on opposite side of glass exactly behind sign being installed. This blank glass back up is to be the same size as sign being installed.
- H. Contractor will be responsible for verifying that behind each sign location there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.
- I. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.

**END OF SECTION 10 14 00**



### **3.8.2 SECTION 10 26 00 – WALL PROTECTION AND RUBBER SPEED BUMPS**

#### **3.8.2.1 PART 1 – GENERAL**

##### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2. SUMMARY**

A. Section Includes:

1. Wall guards.
2. Stainless steel corner guards
3. Car park wall and column protection
4. Car park rubber speed bumps

B. Related Sections:

1. Section 087100 "Door Hardware" for metal armour, kicks, mops, and push plates.

##### **1.3. SUBMITTALS**

- A. Product Data: Include construction details, material descriptions, impact strength, and fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

- B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.

- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Wall and Corner Guards: 300mm long. Include examples of joinery, corners, end caps, top caps, and site splices.
2. Handrails: 300mm long. Include examples of joinery, corners, and site splices.
3. Impact-Resistant Wall Covering: 150 by 150mm square.

D. Qualification Data: For qualified Installer.

- E. Material Certificates: For each impact-resistant plastic material, from manufacturer.

- F. Material Test Reports: For each impact-resistant plastic material.

- G. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.

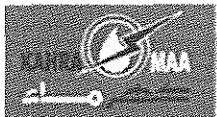
1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

- H. Warranty: Sample of special warranty.

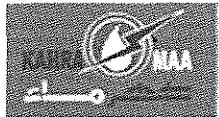
##### **1.4. QUALITY ASSURANCE**

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

- B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.



- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Division 01 Section "Quality Requirements."
    - 1. Do not modify intended aesthetic effects, as judged solely by Engineer, except with Engineer approval. If modifications are proposed, submit comprehensive explanatory data to Engineer for review.
  - D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.
- 1.5. DELIVERY, STORAGE & HANDLING**
- A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
    - 1. Maintain room temperature within storage area at not less than 21 deg C during the period plastic materials are stored.
    - 2. Keep plastic sheet material out of direct sunlight.
    - 3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 21 deg C
      - a. Store corner-guard covers in a vertical position.
      - b. Store wall-guard covers in a horizontal position.
- 1.6. PROJECT CONDITIONS**
- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 21 deg C for not less than 72 hours before beginning installation and for the remainder of the construction period.
- 1.7. WARRANTY**
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
    - 1. Failures include, but are not limited to, the following:
      - a. Structural failures.
      - b. Deterioration of plastic and other materials beyond normal use.
    - 2. Warranty Period: Five years from date of Substantial Completion.
- 1.8. EXTRA MATERIALS**
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    - 1. Wall-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, colour, and texture of units installed, but no fewer than two, 2.5m long units.
    - 2. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, colour, and texture of units installed, but no fewer than two, 1.25m long units.



- B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

### 3.8.2.2 PART 2 – PRODUCTS

#### 1.1. MATERIALS

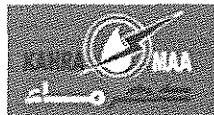
- C. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral colour throughout; extruded material, thickness as indicated.
1. Impact Resistance: Minimum 1356 J/m of notch when tested according to ASTM D 256, Test Method A.
  2. Chemical and Stain Resistance: Tested according to ASTM D 543.
  3. Self-extinguishing when tested according to ASTM D 635.
  4. Flame-Spread Index: 25 or less.
  5. Smoke-Developed Index: 450 or less.
- D. Aluminium Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221M for Alloy 6063-T5.
- E. Stainless-Steel Sheet: ASTM A 240/A 240M.
- F. Fasteners: Aluminium, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

#### 1.2. WALL GUARDS

- A. Refer to drawings for nominated locations.
- B. Crash Rail: Heavy-duty assembly consisting of continuous snap-on plastic cover installed over concealed retainer system; designed to withstand impacts.
1. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  2. Substitutions: See Section 016000 - Product Requirements.
  3. Cover: Extruded rigid plastic, minimum 2.5mm wall thickness; as follows:
    - a. Profile: Flat
      - 1) Dimensions: Nominal 150 to 200mm high by 25mm deep.
      - 2) Surface: Uniform or Grooved.
    - b. Colour and Texture: As selected by Engineer from manufacturer's full range.
  4. Continuous Retainer: Minimum 2.0-mm thick, one-piece, extruded aluminium.
  5. Retainer Clips: Manufacturer's standard impact-absorbing clips designed for heavy-duty performance.
  6. Bumper: Continuous rubber or vinyl bumper cushion(s).
  7. End Caps and Corners: Prefabricated, injection-moulded plastic; matching colour cover; site adjustable for close alignment with snap-on cover.



8. Accessories: Concealed splices and mounting hardware.
  9. Mounting: Surface mounted directly to wall.
- C. Car Park Horizontal Rubber Wall Guard: Heavy duty assembly consisting of high impact-resistant rubber profiles; including mounting hardware; fabricated with 90° angle and reflective yellow stripe.
1. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  2. Substitutions: See Section 016000 - Product Requirements.
  3. Rubber guard: Profiled rubber, minimum 25mm thickness.
    - a. Guard Size: Minimum 200mm high
    - b. Length: 12m lengths to be cut as required
    - c. Weight per metre: Minimum 6.5kg
    - d. Colour: Black with central yellow stripe.
  4. Mounting: Galvanised or stainless steel bolts and wall anchors as suited to the substrate – to Engineer approval.
- 1.3. CORNER GUARDS
- A. Refer to drawings for nominated locations.
  - B. Car Park High Impact Resistant Rubber Corner Guards: Assembly consisting of extruded rubber corner profiles; including mounting hardware; fabricated with 90° angle.
    1. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
    2. Substitutions: See Section 016000 - Product Requirements.
    3. Rubber guard: Extruded rubber, minimum 8mm thickness.
      - a. Wing Size: Nominal 100mm by 100mm
      - b. Length: 1.2m
      - c. Colour: Black with yellow stripes.
    4. Metal Backing Plate: Aluminium or galvanised steel
    5. Mounting: Surface-mounted with M6 / M8 bolts with anchors
  - C. Surface-Mounted, Metal Corner Guards : Fabricated from one-piece, formed or extruded metal with formed edges; with 90° angle or as required to match wall condition.
    1. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
    2. Substitutions: See Section 016000 - Product Requirements.
    3. Material: Stainless steel, Type 304.
      - a. Thickness: Minimum 1.3mm
      - b. Finish: Directional satin, No. 4.
    4. Wing Size: Nominal 40mm by 40mm
    5. Corner Radius: nom 3mm
    6. Mounting: Oval head, countersunk screws through factory-drilled mounting holes.



#### 1.4. SPEED GUARDS/BUMPS

- A. Refer to drawings for nominated locations.
- B. Car Park Rubber Speed Bump : Heavy duty assembly consisting of high impact-resistant rubber profiles; including mounting hardware; fabricated with 90° angle and reflective yellow stripe.
  - 1. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  - 2. Substitutions: See Section 016000 - Product Requirements.
  - 3. Rubber hump: Profiled unitised rubber segments, minimum 25mm thickness.
    - a. Hump height: 60mm high with sloped sides as per manufacturer's standard
    - b. End pieces: manufacturer's standard
    - c. Length: As indicated on drawing.
    - d. Width: Minimum 300mm
    - e. Colour: Black and yellow modules to be alternated.
  - 4. Mounting: Stainless steel M10 /M12 bolts with anchors into concrete slab – to Engineer approval.

#### 1.4. FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize site assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven colouration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

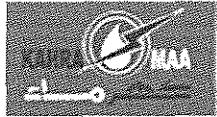
#### 1.5. MATERIAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Remove tool and die marks and stretch lines, or blend into finish.
  - 2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 3. Run grain of directional finishes with long dimension of each piece.
  - 4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

#### 3.8.2.3 PART 3 - EXECUTION

##### 1.1. EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.



- B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  - 1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **1.2. PREPARATION**

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

#### **1.3. INSTALLATION**

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  - 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings or, if not indicated, at heights indicated below:
    - a. Crash Rails: 900mm above finished floor.
  - 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
    - a. Provide anchoring devices to withstand imposed loads.
    - b. Where splices occur in horizontal runs of more than 6m splice aluminium retainers and plastic covers at different locations along the run, but no closer than 300mm.
    - c. Adjust end and top caps as required to ensure tight seams.

#### **1.4. CLEANING**

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

**END OF SECTION 10 26 00**



### **3.8.3 SECTION 10 28 00 – SANITARYWARE & ACCESSORIES**

#### **3.8.3.1 PART 1- GENERAL**

##### **1.1. SECTION INCLUDES**

- A. Supply and install accessories for washrooms, showers and other rooms as indicated on drawings and as specified in this Section.
- B. Supply and install sanitary ware as indicated on drawings and as specified in this Section.

##### **1.2. RELATED REQUIREMENTS**

###### **A. Related Requirements:**

1. Civil & Structural Specifications - Cast-in-Place Concrete
2. Section 042000 - Unit Masonry Assemblies
3. Section 093000 - Tiles
4. All related sections in MEP Specifications.

##### **1.3. SUBMITTALS**

###### **A. See Section 013000 - Administrative Requirements, for submittal procedures.**

###### **B. Shop Drawings:**

1. Submit shop drawings of each specified accessory showing construction details, materials, anchorage, and installation information for the Engineer approval prior to fabrication.
2. Submit floor plans identifying exact location and mounting height for all sanitary ware and accessories. Identify each type of sanitary ware and accessory on floor plans at each location.
3. Submit manufacturer's Product Data indicating handling instructions, anchorage information, roughing-in dimensions, and templates for installation of products specified in this Section.

#### **3.8.3.2 PART 2 – PRODUCTS**

##### **2.1. MANUFACTURERS**

- A. Refer to Sanitary Schedule (Appendix A) for Sanitary Fixtures Schedule for information on approved products and manufacturers.
- B. Substitutions: See Section 016000 - Product Requirements.

##### **2.2. MATERIALS**

###### **A. Washroom Fittings:**

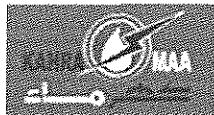
1. Refer to Appendix 3A -Sanitary Schedule and for the required Sanitary Ware types.
2. Contractor to include for all associated fittings and fitments necessary for a complete installation of all sanitary ware and accessories.

###### **B. Refer to Appendix 3A - Sanitary Schedule for product description.**

#### **3.8.3.3 PART 3 – EXECUTIONS**

##### **1.1. PREPARATION**

- A. Take all measurements at building before proceeding with any part of this work. Contractor shall accept work of other trades as found and all dimensions governing this work shall be taken from actual conditions.



## 1.2. INSTALLATION

- A. Install products as specified by manufacturer's written instructions.
- B. Install products plumb, level, straight, tight and secure to mounting surfaces, and centered between joints on masonry and tile walls.
- C. Attach accessories to walls with only:
  1. 38mm long expansion shields in solid masonry or in concrete, or as indicated in writing by manufacturer.
  2. Toggle bolts in cells of hollow masonry units.
  3. Provide solid wood backing behind all sanitary ware and accessories at gypsum board assemblies.
  4. Use only fasteners that match material and finish of fastened products where exposed to view.

**END OF SECTION 10 28 00**

## 3.8.4 SECTION 10 51 16 – WOOD LOCKERS

### 3.8.4.1 PART 1 – GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2. SUMMARY

- A. Section Includes:

1. Wood lockers with plastic-laminate-faced wood doors.

#### 1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wood lockers.
- B. Shop Drawings: For wood lockers. Include plans, elevations, sections, details, and attachments to other work.
  1. Show details full size.
  2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  3. Show locations and sizes of cut-outs and holes for items installed in wood lockers.
  4. Show wood locker fillers, trim, base, sloping tops, and accessories.
  5. Show wood locker numbering sequence.
- C. Samples for Initial Selection: For the following:
  1. Factory-applied finishes.
  2. High-pressure decorative laminates.
  3. Thermoset decorative overlay panels.
- D. Samples for Verification: For the following:
  1. Plastic-laminate-clad panels, not less than 200 by 250 mm, for each type, colour, pattern, and surface finish.



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2. Thermoset decorative-overlay-surfaced panels, not less than 200 by 250 mm, for each type, colour, pattern, and surface finish.
  3. Corner pieces of wood locker front frame joints between stiles and rail, as well as exposed end pieces, not less than 450 mm wide by 450 mm high by 150 mm deep.
  4. Exposed cabinet hardware and accessories, one unit for each type and finish.
- 1.4. **INFORMATIONAL SUBMITTALS**
- A. Qualification Data: For qualified Installer.
  - B. Warranty: Sample of special warranty.
- 1.5. **CLOSEOUT SUBMITTALS**
- A. Maintenance Data: For adjusting, repairing, and replacing wood locker doors and latching mechanisms to include in maintenance manuals.
- 1.6. **MAINTENANCE MATERIALS SUBMITTALS**
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    1. Full-size wood locker doors complete with specified door hardware. Furnish no fewer than five doors of each type and colour installed.
    2. Full-size units of the following wood locker hardware items equal to 10% of amount installed for each type and finish installed, but no fewer than five units:
      - a. Hinges.
      - b. Pulls.
      - c. Shelf rests.
      - d. Cylinder locks.
- 1.7. **QUALITY ASSURANCE**
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
  - B. Source Limitations: Obtain wood lockers with integrated locker benches, and accessories from single source from single manufacturer.
  - C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
    1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
    2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
  - D. Pre-installation Conference: Conduct conference at Project site.
- 1.8. **DELIVERY, STORAGE & HANDLING**
- A. Do not deliver wood lockers until painting and similar operations that could damage wood lockers have been completed in installation areas. If wood lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are same as that in final installation location and comply with requirements specified in "Project Conditions" Article.



- B. Deliver master and control keys to Owner by registered mail, overnight package service or delivery onsite as required.

**1.9. PROJECT CONDITIONS**

- A. Environmental Limitations: Do not deliver or install wood lockers until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature between 16 and 32 deg C and humidity conditions between 17 and 50% at occupancy during the remainder of the construction period.

- B. Field Measurements: Verify actual dimensions of concealed framing, blocking, and reinforcements that support wood lockers by field measurements before fabrication.

**1.10. COORDINATION**

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that wood lockers can be supported and installed as indicated.

**1.11. WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of wood lockers that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures.
- b. Faulty operation of locks or hardware.
- c. Deterioration of wood, wood finishes, and other materials beyond normal use.

2. Warranty Period: Three years from date of Substantial Completion.

**3.8.4.2 PART 2 - PRODUCTS**

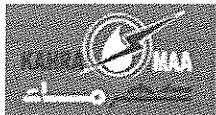
**1.1. MANUFACTURERS**

- A. Manufacturers: Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.

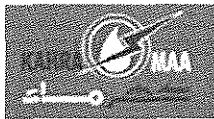
- B. Substitutions: See Section 016000 - Product Requirements.

**1.2. MATERIALS**

- A. Solid Wood: Clear hardwood lumber, selected for compatible grain and colour.
- B. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Thermoset Decorative Overlay: Surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1 for application over particleboard or medium-density fiberboard.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as follows:
- E. Horizontal Surfaces: To manufacturer's standard.
- F. Post formed Surfaces: To manufacturer's standard.
- G. Vertical Surfaces: To manufacturer's standard.
- H. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15% moisture content.



- I. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
  1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as indicated on Drawings.
  2. Provide toothed-steel or lead-expansion sleeves for drilled-in-place anchors.
- J. Coated Steel Support Base: Galvanized steel treated with manufacturer's standard powder coating. Colour to be approved by Engineer.
- 1.3. WOOD LOCKER HARDWARE
  - A. General: Provide manufacturer's standard wood locker hardware set. To be reviewed and approved by Engineer.
  - B. Exposed Hardware Finishes: Polished chrome or Satin chrome unless otherwise indicated.
- 1.4. DOOR LOCKS
  - A. General: Provide manufacturer's standard wood locker hardware set. To be reviewed and approved by Engineer.
- 1.5. PLASTIC LAMINATE FACED WOOD LOCKERS
  - A. Construction Style: Manufacturer's standard.
  - B. Locker Body: Fabricated from particleboard core panels covered on both sides with thermoset decorative overlay.
    1. Side Panels: Manufacturer's standard detail.
    2. Back Panel: Manufacturer's standard detail.
    3. Bottom Panel: Manufacturer's standard detail.
    4. Exposed Panel Edges: Manufacturer's standard detail.
    5. Plastic-Laminate-Faced Wood Doors: High-pressure decorative laminate, Grade VGS, over both sides of particleboard and medium-density-fiberboard core.
    6. Thickness: Manufacturer's standard detail.
    7. Panel Edges: Manufacturer's standard detail.
    8. End Panels: Manufacturer's standard detail.
  - C. Shelves: Manufacturer's standard detail.
    1. Thickness: Manufacturer standard.
    2. Exposed Edges: Manufacturer standard.
  - D. Drawer Faces: Match style, material, construction, and finish of plastic-laminate-faced wood doors. Attach drawer faces to sub fronts with mounting screws from interior of drawer.
  - E. Corners and Filler Panels: 19-mm thick panels. Match style, material, construction, and finish of plastic-laminate-faced wood doors.
  - F. Plastic-Laminate Colours, Patterns, and Finishes:  
As selected by Engineer from plastic-laminate manufacturer's full range of solid colours.
- 1.6. LOCKER ACCESSORIES



- A. Hooks: Manufacturer's standard, ball-pointed aluminium or steel; nominally chrome finished. Attach hooks with at least two fasteners.
  - 1. Provide hooks as manufacturer standard.
- B. Coat Rods: Manufacturer standard.
- C. Door Trays: Manufacturer standard.
- D. Number Plates: Manufacturer standard. To be approved by Engineer.
- E. Continuous Finish Base: Manufacturer standard.

#### **1.7. FABRICATION**

- A. Fabrication to manufacturer's standard details and requirements.

#### **2.1. FACTORY FINISHES FOR WOOD-FACED WOOD LOCKERS**

- A. General: Finish wood lockers at factory as specified in this Section.
- B. High-Pressure Decorative Laminate: manufacturer's standard to be approved by Engineer.
  - 1. Colour: As selected by Engineer from manufacturer's full range.

#### **3.8.4.3 PART 3 - EXECUTION**

##### **1.1. EXAMINATION**

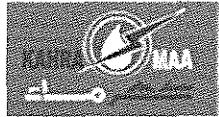
- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting wood locker installation.
- B. Verify that furring is attached to concrete and masonry walls that are to receive wood lockers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

##### **1.2. PREPARATION**

- A. Condition wood lockers to average prevailing humidity conditions in installation areas before installation.
- B. Before installing wood lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

##### **1.3. INSTALLATION**

- A. Install wood lockers level, plumb, and true; use concealed shims.
- B. Connect groups of wood lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit wood lockers accurately together to form flush, tight, hairline joints.
- C. Install wood lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to centre doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Installation Tolerance: No more than 3 mm in 2400-mm sag, bow, or other variation from a straight line. Shim as required with concealed shims.
  - 2. Fasten wood lockers to manufacturer's standard detail. To be approved by the Engineer.
- D. Install number plates after wood lockers are in place.
  - 1. Attach number plate on each wood locker door, near top, centred, with at least two screws with finish matching number plate.



- E. Anchor locker benches to floors if required by manufacturer's standard detail. To be approved by the Engineer.
- 1.4. **ADJUSTING, CLEANING & PROTECTING**
  - A. Clean, lubricate, and adjust hardware. Adjust doors and drawers to operate easily without binding. Verify that integral locking devices operate properly.
  - B. Protect wood lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
  - C. Touch up marred finishes, or replace wood lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by wood locker manufacturer.

**END OF SECTION 10 51 16**

**3.8.5 SECTION 10 520 – FIRE PROTECTION SPECIALTIES**

**3.8.5.1 PART 1 – GENERAL**

**1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2. SUMMARY**

- A. This Section includes fire curtains.

- 1. FC240 Fire Curtain
- 2. FC60 Fire Curtain

- B. Related Sections include the following:

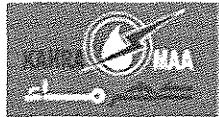
- 1. Division 5 Section "Metal Fabrications" for supplementary metal members supporting Smoke curtain systems to structure.
- 2. Division 16 Sections for electrical wiring and connections and for smoke curtain machines.
- 3. Division 16 Section "Fire Alarm" for connections of smoke curtain machines to fire alarm.

**1.3. STANDARDS & LISTING**

- A. The system shall be Underwriters Laboratories Listed with the requirements of the following standards:

- 1. EN12101-1 – Specification for smoke barriers.
- 2. UL 10C- Positive pressure for fire door assemblies
- 3. UL 10D Listed – Fire Protective Curtains
- 4. UL 10D Oversize Certificate- Each curtain roller barrel shall have a UL listed oversize certificate for up to a 12 meter drop and 6 meters in width
- 5. NFPA 92B- Standard for Smoke Management Systems in Mall, Atria and Large Spaces
- 6. NFPA 70-National Electric code
- 7. The system shall operate under the power of gravity at all times to prove correct gravity fail safe capability.
- 8. The system manufacturer shall be certified to ISO 9001 1994 for the design, manufacture, installation and commissioning of Automatic Smoke Barriers.

**1.9 SUBMITTALS**



- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for automatic smoke curtains. Include plans, sections, details, attachments to other work, and the following:
  1. Operating clearances.
  2. Requirements for supporting automatic smoke curtains, track, and equipment. Verify capacity of each track and rigging component to support loads.
  3. Locations of equipment components, switches, motors and controls. Differentiate between manufacturer-installed and field-installed wiring.
- C. Samples for Verification: For each type of fabric from dye lot to be used for the Work, with specified treatments applied, and showing complete pattern and texture repeat, if any. Mark top and face of fabric. Prepare Samples of size indicated below.
  1. Size: Not less than 36 inches (900 mm) square.
- D. Product Certificates: For each type of product, signed by product manufacturer.
- E. Qualification Data: For Installer. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Maintenance Data: For automatic curtains to include in maintenance manuals.
- G. Warranties: Special warranties specified in this Section.

#### **1.10 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm or individual experienced in installing automatic smoke curtains similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

#### **1.11 PROJECT CONDITIONS**

- A. Field Measurements: Verify smoke-curtain openings and the dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings.

#### **1.12 WARRANTY**

- A. Warranty Period: One year from date of Substantial Completion.

#### **3.8.5.2 PART 2 – PRODUCTS**

##### **1.1 AUTOMATIC FIRE CURTAINS**

- A. Construction:
  1. The curtain head box shall be manufactured from 1.2mm galvanized steel. The enclosure shall be rated at the same temperature as the curtain fabric.
  2. Removable cover plates shall be incorporated to allow access to the curtain rollers.
  3. Standard head box sizes shall be 150mm x 150mm for single rollers (maximum width 5.5m) and 250mm x 150mm for multiple rollers (over 5.5m wide). Larger head boxes may be required where the curtain drop is in excess of 3m.



4. A suitably weighted bottom bar shall be provided to prevent deflection and ensure correct operation under gravity. A polycarbonate extrusion shall be supplied as standard and shall be located in the profile formed in the bottom of the box.
5. The roller shall be constructed from an octagonal tube which will incorporate a 24v d.c. motor and gearbox and a sealed heavy duty ball bearing assembly.
6. A motor control circuit housed in a steel enclosure shall be mounted onto the motor end of the head box.
7. Provide each motorized curtain with back EMF controlled speed of descent of no less than 6 inches per second and no more than 24 inches per second.
8. The fabric curtain shall be manufactured from X32K woven glass fiber cloth incorporating a 'Panama' weave for increased stability. The fabric shall have a nominal weight of 540g/square meter and shall be tested to withstand temperatures of up to 1000C for a period of 60 minutes.
9. Products: Subject to compliance with requirements.
10. Colours: As selected by Engineer from manufacturer's full range.
11. Manufacturers
  - a. U.S. Smoke & Fire Services LLC
  - b. U.S. Smoke & Fire Curtain LLC
  - c. HAG

#### **3.8.5.3 PART 3 - EXECUTION**

##### **1.1. EXAMINATION**

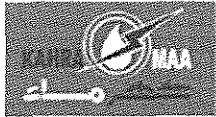
- A. Examine areas and conditions, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of automatic smoke-curtain work. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine inserts, clips, blocking, or other supports required to be installed by others to support boxes. Proceed with installation only after unsatisfactory conditions have been corrected.

##### **1.2. INSTALLATION, GENERAL**

- A. Install automatic smoke-curtain system according to fabricator's written instructions.

##### **1.3. OPERATION**

- A. The smoke curtain shall deploy upon a signal from the fire alarm system in an emergency situation.
- B. The system must be proven to fail safe to the operational position on total loss of primary and auxiliary power.
- C. Under normal operating conditions the curtains would be held in the retracted position via the motors operating at low voltage. The manufacture must be able to confirm that the motor windings are suitable for this type of operation.



- D. Upon activation of the fire alarm the control panel will remove the supply voltage and the curtain shall descend under the power of gravity in a controlled manner. A dynamic braking system housed in the motor control circuit shall control the speed of the descent of the curtain. The descent shall be electronically synchronized on overlapping curtains with a bottom bar.
- E. To retract the curtain the control panel shall supply 24v to the motor control circuits and motors will drive the curtains to the upper position. As the bottom bar or stopping bar hits the curtain head box a current limiting circuit will step back the voltage and current and hold the bottom bar in the retracted position.
- F. Limit switches are not to be used to control the upper position of the curtain.
- G. An optional braking system must be available at the manufacture stage to allow a two stage descent during gravity deployment. Should the main power fail to the group control panel, the supply is automatically switched to the integral standby battery. The curtain remains in the retracted position for 1 hour (fully retracted) loaded system). The curtain will remain fully operational until the battery low voltage cut off facility reads a voltage of 21v; the curtains will then safely descend under the power of gravity to the operational position.
- H. Group- Control Panel: Provide Group Control panel (GCP) capable of controlling up to 6 no. BLE24v motor assemblies. During normal operation, the GCP will provide a 24v AC supply to the curtain motor holding them in the retracted position. Should smoke be detected, the fire alarm contact in the GCO will be opened by the fire alarm control system, the GCP will remove the 24v supply to the curtain motors and the curtains will descend under the power of gravity in a controlled manner.
- I. Open on fire- configured to be gravity fail safe
- J. Test Facility- key switch
- K. Indication- Green led= Mains Healthy; Yellow LED= Battery Fault; Red LED= Fuse Blown; Green LED= Fire alarm Status Normal

#### 1.4 MONITORING

- A. Monitoring relays shall be installed in the group control panel to provide BMS contacts for mains failure and curtain zone deployment.
- B. Monitoring relays shall be installed in the motor control circuits to provide BMS contacts for individual curtain deployment.

#### 1.5 ACCEPTANCE TESTING

- A. Fire alarm testing, the smoke curtain is required to deploy upon a signal from the fire alarm in an emergency situation. The test to verify deployment shall be conducted in the presence of the authority having jurisdiction per NFPA guidelines.
- B. When a smoke curtain is required to deploy in an emergency situation, it is probable that the main supply to the control panel may have already failed and that the cables linking the curtains to the control panel might have become damaged. Under these circumstances with no power available the curtain will have to deploy by gravity.
- C. A total power failure should be simulated during each test to ensure gravity fail safe deployment. A test in which a curtain is powered down under normal test conditions from either main power or the battery



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supply only proves that the smoke curtain can be deployed when powered. This does not confirm an ability to be gravity fail safe.

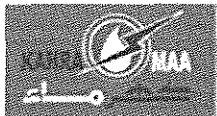
**1.6. DEMONSTRATION**

- A. Engage a factory-authorized service representative to test system and to train Owner's Personnel to rig, adjust, operate, and maintain automatic smoke curtains.

**3.1 ANNUAL TESTING & MAINTENANCE**

- A. Engage a factory authorized service representative to test, adjust and maintain system once per annum.

**END OF SECTION 10 520**



### 3.9 DIVISION 11 EQUIPMENTS

#### 3.9.1 SECTION 11 12 00 - PARKING CONTROL EQUIPMENT

##### 3.9.1.1 PART 1 – GENERAL

###### 1.1. SECTION INCLUDES

- A. Parking gate access and exit devices, controllers, and barriers.
- B. Provision of conduits in concrete slab required for wired connections and electric power to connect to parking equipment is included in relevant sections under Division 16.

###### 1.2. RELATED REQUIREMENTS

- A. Related Requirements:

- 1. MEP Specifications

###### 1.3. REFERENCE STANDARDS

- A. Related Standards:

- 1. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.
  - 2. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2006.
  - 3. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.
  - 4. UL (EAUED) - Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc.; current edition.

###### 1.4. SUBMITTALS

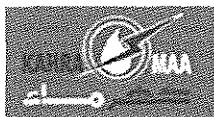
- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate plan layout of equipment access lanes.
- C. Product Data: Provide data on operating equipment, characteristics and limitations, operating temperature ranges.
- D. Samples: Submit two samples of access cards illustrating size.
- E. Project Record Documents: Record actual locations of concealed conduit.
- F. Operation Data: Provide operating data for the operating equipment.
- G. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Kahramaa's name and registered with manufacturer.

###### 1.5. QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.

###### 1.6. REGULATORY REQUIREMENTS

- A. Conform to applicable code for emergency vehicle access.
- B. Conform to applicable code for paint finish and marking on gate arm.



- C. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

**1.7. PROJECT CONDITIONS**

- A. Coordinate the placement of equipment frames and anchors.
- B. Coordinate the placement of conduit and accessories and the power wiring to operating equipment.
- C. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

**1.9. WARRANTY**

- A. See Section 017700 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for operating equipment.
- C. Provide service and maintenance of operating equipment for a period of two years from Date of Substantial Completion.
- D. See Section 016000 - Product Requirements, for additional provisions.
- E. Supply two extra gate arm assemblies for Kahramaa's use in maintenance of project.

**3.9.1.2 PART 2 - PRODUCTS**

**1.1 MANUFACTURERS**

- A. Parking Control Equipment:
  - 1. Recognized manufacturer having an official technical data and approved description in conformity with standards for the product here in, and approved by the Engineer.
  - 2. Substitutions: See Section 016000 - Product Requirements.

**1.2. PARKING CONTROL EQUIPMENT**

- A. Parking Control: Remote control operation at entrance and automatic operation at exit.
  - 1. Design: Protect against interference or damage by lightning or other electrical influence; include fuse, over-voltage protection, flash-over protection, and line filter.
  - 2. Entry: Automatic gate electrically operated upon activation of remote control device.
  - 3. Exit: Automatic gate electrically operated upon detection of vehicle by sensor fixed to the barrier pillar.

**1.3. GATE ARMS**

- A. Gate Arms: Box aluminium with clamp attachment to shaft, installed 990mm above pavement. Provide neoprene padding on lower edge of gate arm to prevent damage to vehicle in case of accidental or premature lowering of arm. When arm meets obstruction it shall revert completely to open position.
- B. Gate Arm Shaft: provide with permanently lubricated bearings.
- C. Gate Arm Motor: Heavy duty sleeve bearing capacitor type motor with:
  - 1. Solenoid operated brake control.
  - 2. Control by heavy duty relay with ample current carrying contacts to operate the full starting load.
  - 3. Thermal overload circuit breaker protection with automatic re-set.
  - 4. Additionally fused protection for motor, relay and solenoid power.
  - 5. Provide mechanical means to operate gate arm to raise/lower in case of power or system failure.



6. TEFC motor with capacitor to maintain power factor at 0.95 lagging. Electrical works shall be carried out in accordance with Electrical Specifications.
  - D. Gate Control Panel: The panel shall contain the 24volt DC power supply with solid state components throughout, as well as manual control switches and circuit breaker protection of the AC supply and low voltage power source. Contain the control circuitry on a pluggable glass epoxy board unit that determines the mode of gate operation. Provide key switch to raise, lower and select automatic functioning of the gate. Provide a control to activate or inactivate the safety device. Control panel shall be constructed to IP54 and have a lockable perspex front door. Control panel shall be provided with a power disconnect and be concealed (flush) mounted in the security post at the parking entrance. Earth fault protection shall be provided for perhaps 3 motors.
  - E. Power 240volts, single phase, 50Hz or 415Volts, three phases, 50 Hz.
  - F. Provide necessary contacts for security systems in addition to 2 No./2NC spare contacts.
  - G. Provide annunciation hooter to sound in case of gate left open. Gate to be closed in this event by remote control only. Provide flashing amber light on the base assembly.
- 1.4. FABRICATION
- A. Fit joints and junctions between components tightly, in true planes, and to prevent entry of water to collect in component voids.
  - B. Work with materials and component sizes, metal gauges reinforcing, anchors and fastenings of adequate strength to ensure that it will remain free of warping, buckling, opening of joints and seams and distortion within limits of intended and specified use. Conceal and weld connections.
  - C. Cleanly and smoothly finish exposed edges of materials including holes.
  - D. Incorporate reinforcing and attached anchorage for built-in products.
  - E. Incorporate holes and connections for work installed under other sections of this Specification

### 3.9.1.3 PART 3 – EXECUTIONS

#### 1.1. EXAMINATION

- A. Verify that anchor bolts are ready to receive work and dimensions are as indicated on shop drawings.
- B. Verify that electric connections are correctly located and of the correct characteristics.

#### 1.2. INSTALLATION

- A. Install parking control system and components in accordance with manufacturer's instructions.
- B. Install internal electrical wiring, conduit, junction boxes, transformers, circuit breakers, and auxiliary components required.

#### 1.3. ADJUSTING

- A. Adjust system components for smooth operation.

**END OF SECTION 11 12 00**

### 3.9.2 SECTION 11 26 00 - UNIT KITCHENS

#### 3.9.2.1 PART 1 – GENERAL

#### 1.1. RELATED DOCUMENTS



- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2. SUMMARY**

- A. Section includes factory-fabricated and -assembled unit kitchens with laminate-clad cabinets, countertops, fixtures, appliances, and accessories.

B. Related Sections:

1. Section 113100 "Residential Appliances" for standard manufactured residential kitchen appliances.
2. Section 123530 "Residential Casework" for stock manufactured kitchen casework and countertops.
3. Section 224100 "Residential Plumbing Fixtures" for kitchen sinks waste disposers and instant-hot-water dispensers furnished as plumbing fixtures.
4. Section 231123 "Facility Natural-Gas Piping" for gas connections to unit kitchen appliances.
5. Section 233113 "Metal Ducts" for ducted extensions and fans for exhaust hoods and range hoods of unit kitchens.

**1.3. ACTION SUBMITTALS**

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, finishes, furnished specialties, and accessories. Include rated capacities, operating characteristics, and utility requirements of appliances.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- C. Retain subparagraph below if equipment includes wiring.

- D. Wiring Diagrams: For power, signal, and control wiring.

- E. Samples for Initial Selection: For units with factory-applied colour finishes.

- F. Delete "Samples for Initial Selection" Paragraph above if colors and other characteristics are preselected and specified or scheduled. Retain paragraph below with or without above.

- G. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

- H. Metal finish for cabinets and countertops, 8 by 10 inches (200 by 250 mm).

- I. Wood finish for cabinets, 8 by 10 inches (200 by 250 mm).

- J. Plastic laminate for cabinets and countertops, 8 by 10 inches (200 by 250 mm).

- K. Solid surfacing for countertops, 6 inches (150 mm) square.

- L. One full-size unit of each type of exposed hardware.

**1.4. INFORMATIONAL SUBMITTALS**

- A. Retain first paragraph below for product certificates from manufacturers.

- B. Product Certificates: For each type of unit kitchen, from manufacturer.

- C. Retain first paragraph below if retaining "Manufacturer Qualifications" Paragraph in "Quality Assurance" Article.

- D. Manufacturer Certificate: Signed by manufacturer certifying that units comply with requirements.

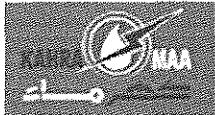
- E. Warranty: Sample of special warranty.

**1.5. CLOSEOUT SUBMITTALS**



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- A. Maintenance Data: For unit kitchen appliances to include in maintenance manuals.
- 1.6. **QUALITY ASSURANCE**
  - A. Retaining option in first paragraph below will assure that manufacturer has the greatest control over the quality of components used, but may decrease competition and increase costs.
  - B. Manufacturer Qualifications: A qualified manufacturer that fabricates unit kitchens and their components.
  - C. Source Limitations: Obtain unit kitchens from single source from single manufacturer.
  - D. Verify accessibility requirements with authorities having jurisdiction. Some projects may require compliance with multiple accessibility regulations.
  - E. Regulatory Requirements: Where unit kitchens are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines ICC/ANSI A117.1 HUD's "Fair Housing Accessibility Guidelines".
  - F. Electrical Components, Devices, and Accessories: Listed and labelled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    - 1. Built-in Refrigerators: Listed and labelled for recessed installation. Mount label to be visible after installation of unit; include electrical rating, type of refrigerant, and minimum installation clearances.
    - 2. Refrigerated Unit Kitchens and Wet Bars: Listed and labelled for entire unit as a single integrated system. Mount label to be visible after installation of unit; include electrical rating, type of refrigerant, and minimum installation clearances.
  - G. Wood Laminate-Clad Cabinet Fabrication Standards.
    - 1. KCMA A161.1. Provide cabinets with KCMA's "Certified Cabinet" seal affixed to a semi-exposed location of each unit and showing compliance with standard.
    - 2. AWI 400B, Custom grade.
    - 3. Either fabrication standard above.
  - H. Appliance Standards:
    - 1. Refrigerators and Freezers: UL 250 or AHAM ER-1.
    - 2. Electric Ranges: UL 858 or AHAM HRF-1.
    - 3. Microwave Ovens: UL 923.
    - 4. Gas-Burning Appliances: ANSI Z21 Series, and certified by CSA International, UL, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- 1.8. **DELIVERY, STORAGE, AND HANDLING**
  - A. Deliver factory-assembled units, individually factory packaged and protected. Label with manufacturer's name, product name, and model number.
- 1.7. **PROJECT CONDITIONS**
  - A. Environmental Limitations: Do not deliver or install unit kitchens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - B. Field Measurements: Verify actual dimensions of construction contiguous with unit kitchens by field measurements before fabrication.
- 1.8. **COORDINATION**



- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that unit kitchens can be supported and installed as indicated.
- B. Coordinate wiring requirements and current characteristics of unit kitchens with building electrical system.
- C. Coordinate layout and installation of plumbing, mechanical, and electrical services for unit kitchens.

**1.9. WARRANTY**

- A. Special Warranty:
  - 1. Warranty Period: Five years from date of Substantial Completion.

**3.9.2.2 PART 2 – PRODUCTS**

**2.1. MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements.

**1.1. MATERIALS**

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- B. Porcelain-Enamel-Finished Steel Sheet: ASTM A 424, enamelling-grade steel, uncoated thickness indicated; with exposed face and edges coated with primer, ground coat, and colour cover coat; and concealed face coated with primer and ground coat; acid resistant.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- D. Certified Wood: Fabricate cabinets and countertops from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- E. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers." Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea-formaldehyde resin.
- F. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea-formaldehyde resin.
- G. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, Type I, made with materials containing no urea formaldehyde.
- H. Solid Wood: Clear hardwood lumber of species indicated, free of defects, selected for compatible grain and colour, and kiln dried to 7% moisture content.
- I. High-Pressure Decorative Laminate: NEMA LD 3.
- J. Solid-Surfacing Material: Homogenous solid sheets fabricated from reacted monomers and resins, mineral fillers, and pigments; in thickness indicated; complying with ISSFA-2.
- K. Adhesives: Do not use adhesives that contain urea formaldehyde.
- L. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**1.2. METAL CABINETS**



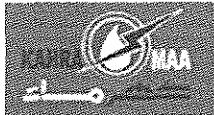
- A. Steel Base Cabinets: Fabricate frames and sides from 0.75-mm nominal-thickness, cold-rolled steel sheet; welded and reinforced with internal gussets and bracing; with baked-enamel finish.
  - 1. Door and Drawer Fronts: 0.75-mm nominal-thickness, cold-rolled steel sheet, textured or smooth; welded, reinforced, and sound-deadened; with baked-enamel finish.
  - 2. Door and Drawer Fronts: 0.95-mm thick, stainless-steel sheet; welded, reinforced, and sound deadened.
- B. Stainless-Steel Base Cabinets: Fabricate frames and sides from 0.95-mm thick, stainless-steel sheet; welded and reinforced with internal gussets and bracing.
- C. Door and Drawer Fronts: 0.95-mm thick, stainless-steel sheet; welded, reinforced, and sound deadened.
- D. Under-counter Storage Cabinet: Same material and finish as base cabinets, with adjustable shelf and drawer or with two drawers.
- E. Wall Cabinets: Same material and finish as base cabinets, with flush double bottoms and adjustable shelves.
  - 1. Wall Shields: Fabricated from stainless-steel sheet. Provide wall shields for back wall and side walls between countertop splash and wall cabinets.
- F. Shelves: Manufacturer's standard rolled-front shelves, [fixed,] [adjustable,] of same material and finish as cabinets.
- G. Wire Pulls: Brushed-chrome.

#### 1.3. LAMINATE-CLAD CABINETS

- A. Framed-Style Base Cabinets:
  - 1. Face Frames: 3/4-inch- (19-mm-) thick plywood or solid wood.
  - 2. Back Panels: 3/8-inch- (10-mm-) thick particleboard with melamine bonded to inside surface.
  - 3. Top, Bottom, and End Panels: 3/8-inch- (10-mm-) thick particleboard with melamine bonded to both sides.
  - 4. Door and Drawer Fronts: 3/4-inch- (19-mm-) thick, medium-density fiberboard with 16-mil- (0.4-mm-) thick vinyl film (Thermofoil) bonded to exposed surfaces and melamine bonded to inside surfaces.
  - 5. Door and Drawer Fronts: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides.
  - 6. Drawers: Four sided, with 1/2-inch- (13-mm-) thick particleboard fronts, backs, and sides, and 1/4-inch- (6-mm-) thick particleboard bottom.
  - 7. Shelves: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides and PVC edges.
- B. Frameless-Style Base Cabinets:
  - 2. Back Panels: 1/4-inch- (6-mm-) thick plywood or particleboard with melamine bonded to inside surface.
  - 3. Top and Bottom Panels: 3/4-inch- (19-mm-) thick particleboard with melamine bonded to both sides.
  - 4. End Panels: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides.



5. Door and Drawer Fronts: 3/4-inch- (19-mm-) thick plywood with Grade HGS high-pressure decorative laminate bonded to front and edges, and Grade CLS high-pressure decorative laminate bonded to inside surface.
  6. Door and Drawer Fronts: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides.
  7. Door and Drawer Fronts: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides. Provide continuous bevel edge at tops and bottoms of doors and bottom of drawer fronts in wood-grain laminate.
  8. Drawers: Four sided, with 1/2-inch- (13-mm-) thick particleboard fronts, backs, and sides, and 1/4-inch- (6-mm-) thick particleboard bottom.
  9. Shelves: 3/4-inch- (19-mm-) thick particleboard with melamine bonded to both sides and PVC edges.
- C. Wall Cabinets: Same material and finish as base cabinets, with adjustable shelves.
1. Wall Shields: Fabricated from high-pressure decorative laminate of grade and colour to match cabinets. Provide wall shields for back wall and side walls between countertop splash and wall cabinets.
- A. Scribe Strips for Recessed Cabinets: Same material, finish, and colour as cabinet.
- B. Wire Pulls: Brushed-chrome finish.
- #### 1.4. FIXTURES
- A. Stainless-Steel Drop-in Sinks: 1.27 mm thick; seamless; single compartment.
- Porcelain-Enamel-Finished Steel Drop-in Sinks: 1.09 mm thick; seamless; single compartment.  
Under-counter Mounted Sinks: Solid-surfacing material; seamless; single compartment.
- B. Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops. To be coordinated with Services Engineer.
- C. Sink Faucet: Single-lever control; polished chrome-plated mixing faucet with limited-swing spout and aerator.
- D. Sink Outlet with Disposer: 3-1/2-inch diameter outlet.
- E. Sink Outlet without Disposer: 3-1/2-inch diameter outlet with stainless-steel cup strainer and 1-1/2-inch diameter tailpiece.
- F. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated cast-brass trap, tubular brass waste to wall, and wall escutcheon.
- G. Bar Sink Outlet: 2-inch- (51-mm-) diameter outlet with stainless-steel grid strainer.
- H. Disposers: Continuous-feed, household, food-waste disposers. Include 115-V ac, 1725-rpm, 1/2-hp motor with overload protection and reset button; three-conductor, grounded power cord; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 (DN 40) outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
- I. Hot-Water Dispensers: Household type with instant on-off control; insulated, corrosion-resistant-metal storage tank that is open to atmosphere; electric, 115-V ac, heating element; three-conductor, grounded power cord; chrome-plated faucet or spout; removable strainer; thermostat control for water temperature



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up to 190 deg F (88 deg C); thermal-overload protection; and minimum 1/2-gal. (1.9-L) tank capacity dispensing approximately 60 cups (240 mL) of water per hour.

#### **1.5. APPLIANCES**

- A. Freestanding, Upright Refrigerator-Freezers: Two-door combination unit with one-piece seamless steel or ABS plastic inner liner; automatic defrost; closed freezer compartment with two adjustable shelves[ and two ice cube trays]; full-width vegetable crisper; dairy compartment; interior light; adjustable automatic temperature control; door with magnetic gaskets and storage shelves; 115-V ac, with three-conductor, grounded power cord.
- B. Electric Cooktops: Porcelain-enamel-finished steel; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights; with wiring terminated at factory-installed junction box.
- C. Built-in Electric Ovens: Porcelain-enamel-finished steel exterior surfaces; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights. Oven interior fabricated from one-piece porcelain-enamel-finished steel with rounded corners, with "Bake" and "Broil" oven elements, automatic heat control, signal light, and removable wire oven rack; textured baked-enamel- or porcelain-enamel-finished steel oven door; 208/240-V ac, with wiring terminated at factory-installed junction box.
- D. Freestanding Microwave Ovens: Manufacturer's standard cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, and tempered glass door; 115-V ac, with three-conductor, grounded power cord.
- E. Ventilating Exhaust Hoods: Under-cabinet mounted, 24 inches (610 mm) wide, baked-enamel steel; two-speed fan control, permanent washable filter, and built-in lighting; 115-V ac, with wiring terminated at factory-installed junction box.
- F. Provide exhaust duct and roof cap and shutter. See Section 233113 "Metal Ducts."
- G. Dishwashers: Built-in under-counter unit, width as Manufacturer's standard.

#### **1.6. ACCESSORIES**

- A. Fluorescent Light Fixtures: Surface mounted to underside of overhead cabinet; with 15-W lamp, on-off switch, grounded convenience receptacle, and translucent plastic lens.
- B. Cutlery Drawers: Concealed drawer in under-counter storage compartment with pull-out divided tray.
- C. Cutting Boards: Pull-out hardwood board.
- D. Heat Shields: Minimum 12 inches high by 24 inches (305 mm high by 610 mm) wide, 0.025-inch- (0.64-mm-) thick stainless steel over 1/4-inch- (6-mm-) thick board insulation.

#### **1.7. FABRICATION**

- A. General: Factory fabricate and assemble unit kitchens, with base cabinets, sink, , refrigerator, and countertop shipping as a one-piece assembly. Securely fasten components, fixtures, and appliances together.



- B. Accessible Units: Fabricate unit kitchens to comply with accessibility regulations as follows: Retain one of first two subparagraphs below.
1. Adjustable, Accessible Countertops: Fabricate unit kitchens with two-piece countertop that allows countertop over sink, including backsplash, side splashes, and sink assembly, to be adjusted between 735 and 915 mm above finished floor.
  2. Removable, Accessible Cabinets: Fabricate cabinet under sink to allow removal for future accessibility conversion. Fabricate cabinet to allow access to plumbing and electrical connections after conversion.
  3. Knee and Toe Clearance: Provide minimum 760-mm wide open space beneath countertop with a minimum clear height of 685 mm above floor for first 205 mm of depth, then reduce clearance at a rate of 25 mm in depth for each 150 mm in height, to a minimum clear height of 230 mm above floor at a depth of 280 mm.
  4. Pipe Enclosure Panels: Provide manufacturer's standard panels to enclose plumbing under countertop, of same material and finish as cabinets. Install panel to prevent exposure of sharp or abrasive surfaces under countertop.
  5. Operable Parts: Locate operable parts no higher than 1219 mm and no lower than 380 mm above floor. Provide operable parts that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 22.2 N.
  6. Range or Cooktop: Provide top surface 865 mm above floor, with controls that do not require reaching across burners. Provide knee and toe clearance beneath range or cooktop; insulate underside of cooktop to prevent burns, shocks, or abrasions.
  7. Refrigerator/Freezer: Provide 50% of freezer space no higher than 1370 mm off floor.
  8. Oven: Provide work surface adjacent to one side of bottom-hinged doors. Locate controls on front panel.
- 1.8. GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- 1.9. FINISHES
- A. Stainless-Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.  
Bright, Directional Polish: No. 4 finish.
- B. Wood Finishes: Factory finished with manufacturer's standard stain, sealer, and clear finish coat. Defer only final touch-up until after installation.
- 3.9.2.3 PART 3 – EXECUTION
- 1.1. EXAMINATION



- A. Examine walls and floors, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

- C. Examine walls and partitions for proper backing for unit kitchens.

- D. Examine roughing-in for electrical power plumbing and mechanical system(s) to verify actual locations of connections before installation of unit kitchens.

- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 1.2. INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims. Provide fasteners, clips, backing materials, brackets, anchors, fillers, scribes, trim, and accessories necessary for complete installation.

1. Anchor unit kitchens at ends and at intervals recommended by manufacturer, but not more than 910 mm o/c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent material distortion; use concealed fasteners.

2. Freestanding Ranges: Install anti-tip anchors at locations recommended by manufacturer.

3. Comply with requirements specified in Section 221116 "Domestic Water Piping," Section 221316 "Sanitary Waste and Vent Piping," and Section 221123 "Domestic Water Pumps" for connecting unit kitchens to plumbing and mechanical system(s).

4. Comply with requirements for connecting unit kitchens to electrical power system.

#### 1.3. ADJUSTING AND CLEANING

- A. Test, adjust, and verify operation of each appliance, plumbing fixture, and component of unit kitchens. Repair or replace items found to be defective or operating below rated capacity.

- B. Verify that operating parts work freely and fit neatly and that clearances are adequate to properly and freely operate appliances.

- C. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that locking devices operate properly.

- D. After completing unit kitchen installation, remove protective coverings if any.

- E. Repair or replace damaged parts, dents, buckles, abrasions, and other defects affecting appearance or serviceability. Touch up factory-applied finishes to restore damaged or soiled areas.

**END OF SECTION 11 26 00**

### **3.9.3 SECTION 11 82 00 - WASTE EQUIPMENTS**

#### 3.9.3.1 PART 1 – GENERAL

##### 1.1 SUMMARY

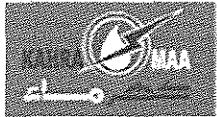
- C. This section includes collection and disposal equipment: waste compactors, balers, and waste bins.

- D. Related Sections

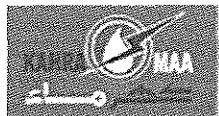
1. The following CSI sections are covered in this Specification:

- a. 11 82 13 Solid Waste Bins

- b. 11 82 26 Recycling Equipment



- c. 11 82 26 Waste Compactors and Destructors
- 1.2 SUBMITTALS**
- A. Product Data: Include rated capacities of container volume, operating characteristics (including lifting bin containers of 1100L size), furnished specialties, and accessories for each of the disposal equipment mentioned.
  - B. Shop Drawings: Drawn to scale. Shop Drawings coordinating compactor installation and details of container lifting system. Shop Drawings coordinating baler machine installations. Shop Drawings coordinating waste bin dimensions.
  - C. Maintenance data for all items mentioned.
  - D. Product certificate: For all parts of compactor, waste bins, and baler to comply with health and safety regulations as per local standards of operations.
  - E. On-site quality control test reports.
  - F. Operation and maintenance data: to include operational and maintenance manual including emergency manual for equipment that shall be operated by personnel.
  - G. Warranties: Include at least 1 year warranty covering any manufacturing defects, maintenance of all waste collections equipment including hydraulic oil change, servicing and spare parts at the minimum. Extension of warranty should be considered.
- 1.3 QUALITY ASSURANCE**
- A. Electrical Components, Devices, and Accessories: Listed and labelled as defined in NFPA 4, Article 100, by a testing agency acceptable to authorities having jurisdiction.
  - B. Waste Compactor and Baler Standards: Comply with BSEN1863: Part 6 and with NFPA 82 AMD 1.
  - C. Waste Bin Standard: Comply with BS EN 1863: Part 6 and with NFPA 82 AMD 1.
- 1.4 DELIVERY, STORAGE, AND HANDLING**
- A. Delivery and assembly shall be by manufacturer. Contractor shall be present during delivery, on- site testing, and assembly.
  - B. Certificate of delivery, assembly and commissioning shall be signed by the Engineer and Contractor.
  - C. Personnel to be trained on commissioning compactor and baler by manufacturer and provided with operational manual.
- 3.9.3.2 PART 2 - PRODUCTS**
- 1.1. MANUFACTURERS**
- A. Waste Compactors: Manufacturer's standard stationary compactor packaged units with components, options, and accessories needed to comply with requirements and provide complete functional systems.
  - B. Products: Subject to compliance with requirements, the following requirements apply to product selection
  - C. Available Products: Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to manufacturers specified.
  - D. Manufacturers: subject to compliance with requirements, provide products by one of the manufacturers mentioned or of equal product.



#### **1.2. WASTE COMPACTORS**

- A. Wilkinson Hi-Rise, LLC, stationary compactor
- B. Werner and Weber, stationary compactor
  - 1. Basis-of-Design Product: The design of each compactor is based on the product and manufacturer. Subject to compliance with requirements, provide either the named product or a comparable manufacturer.
    - a. Orwak Global
- C. General Requirements
  - 1. Minimum Rating Base Size: 8 cu. m
  - 2. Normal/Maximum Packing Forces: 230kN
  - 3. Normal Cycle Time: 30 secs
  - 4. Unit Weight: 3,200 Kg

#### **1.3. BALER**

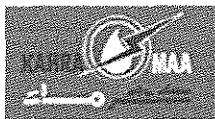
- A. Wilkinson Hi-Rise, LLC, stationary baler for plastic and cardboard
- B. Orwak Global, stationary baler for plastic and cardboard
- C. Basis-of-Design Product: The design of each baler is based on the product and manufacturer. Subject to compliance with requirements.
  - 1. Dulscobaler
- D. General Requirements
  - 1. Minimum bale weight for plastic: 450 kg
  - 2. Minimum bale weight for cardboard: 400 kg
  - 3. Normal Cycle Time: 35 secs
  - 4. Noise level: 62.7 db

#### **1.4. WASTE AND RECYCLING BINS**

- A. Wheelie Eurobin – recycling and general waste b. 26.6 L recycling bin – office use
- B. General Requirements
  - 1. UV resistant
  - 2. Plastic material
  - 3. Rubber-tyred wheels d. Lockable lids
  - 4. Maximum load of 450 kg
  - 5. Minimum 3 different colours shall be available

#### **1.5. FABRICATION**

- A. Fabricate bins, compaction chambers, unit bodies, and similar components of steel plate with welded joints.
- B. Fabricate equipment with replaceable parts at points of normal wear.
- C. Provide electrical devices, controls, and materials of type and quality recommended by NEMA for applications indicated.



### 3.9.3.3 PART 3 – EXECUTION

#### 1.1. INSTALLATION

- A. Set waste compactors level, plumb, properly aligned, and securely in place. Anchor as required for secure operation.
- B. Complete field assembly with joining methods recommended in writing by manufacturer.

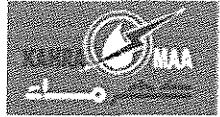
#### 1.2. DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain waste compactors and baler equipment. Refer to Division 01 Section "Demonstration and Training."

#### 1.3. LIST OF MANUFACTURERS, SUPPLIERS AND VENDORS

- A. The following is a list of Manufacturers, Suppliers and VENDORS intended for use in the performance of the WORKS by CONTRACTOR. In case of any change either in the type of WORKS or in the name of the Manufacturers, Suppliers, and VENDORS to be used, CONTRACTOR shall advise Engineer and obtain written approval of the new WORKS or the new Manufacturers, Suppliers and VENDORS to be hired.
- B. Manufacturers, Suppliers and VENDORS shall, unless approved by Engineer prior to award, only be selected from a "List of Manufacturers, Suppliers and VENDORS" prepared by CONTRACTOR in respect of each supply of GOODS and approved by the Engineer, with a technical analysis/comparison of the Manufacturers, Suppliers and VENDORS listed being performed in co-ordination with the Engineer.
- C. Based on Engineer prior approval, additions and deletions may be made to or from the list. Attached is a list of VENDORS which are acceptable to the Engineer. For the avoidance of doubt, the CONTRACTOR may select from this list but is not restricted to the list and may propose alternatives, at his option, for Engineer's approval.
- D. CONTRACTOR shall detail and submit with his tender, the GOODS it proposes to be supplied and the Manufacturers, Suppliers and VENDORS proposed in each instance, together with the approximate value of those GOODS, for each of the proposed Manufacturers, Suppliers and VENDORS, as a percentage (%) of CONTRACTOR's total Lump Sum Fixed and Firm Tender Price.
- E. The mere inclusion of a make in the list of VENDORS does not imply acceptance/approval. All equipment material proposed for use on the project must comply with the Specifications and must be approved by the Engineer (irrespective of make being mentioned in these documents).

Waste Compactor	Werner and Weber Wilkinson Hi-Rise	Austria USA Norway
Waste Bins	Wheelie Eurobin Werner and Weber	UK Austria USA



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Baler Machine	Wilkinson Hi-Rise Orwak Global	USA Norway Austria
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**END OF SECTION 11 82 00**



### **3.10 DIVISION 12 FURNISHINGS**

#### **3.10.1 SECTION 12 35 53 - LABORATORY CASEWORK**

##### **3.10.1.1 PART 1 – GENERAL**

###### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

###### **1.2. SUMMARY**

A. Section Includes:

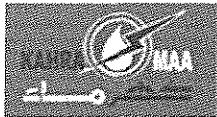
1. Metal laboratory casework, with wood doors and drawer fronts.
2. Wood laboratory casework.
3. Plastic-laminate laboratory casework.
4. Utility-space framing at backs of base cabinets and between backs of base cabinets].
5. Filler and closure panels.
6. Laboratory casework system that includes support and utility-space framing, filler and closure panels, wall panels, undercabinet lighting, and modular countertops.
7. Laboratory countertops.
8. Tables.
9. Shelves.
10. Laboratory sinks and troughs.
11. Laboratory accessories.
12. Water, laboratory gas, and electrical service fittings.

B. Related Sections:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring laboratory casework.
2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.
3. Section 115313 "Laboratory Fume Hoods" for fume hoods, including base cabinets and countertops under fume hoods.

###### **1.3. DEFINITIONS**

- A. MDF: Medium-density fiberboard.
- B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1200 mm) above floor, and visible surfaces in open cabinets or behind glass doors.
1. Ends of cabinets, including those installed directly against walls or other cabinets, are defined as "exposed."
  2. Ends of cabinets indicated to be installed directly against and completely concealed by walls or other cabinets are defined as "concealed."



C. Semi-exposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cabinets 78 inches (1980 mm) or more above floor are defined as "semi-exposed."

D. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

E. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive and faced both front and back with hardwood veneers.

#### 1.4. PERFORMANCE REQUIREMENTS

A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:

1. Support Framing System: 600 lb/ft. (900 kg/m).

2. Suspended Base Cabinets (Internal Load): 160 lb/ft. (240 kg/m).

3. Work Surfaces (Including Tops of Suspended Base Cabinets): 160 lb/ft. (240 kg/m).

4. Wall Cabinets (Upper Cabinets): 160 lb/ft. (240 kg/m).

5. Shelves: 40 lb/sq. ft. (200 kg/sq. m).

B. Delegated Design: Design laboratory casework, including comprehensive engineering analysis by a qualified professional engineer, using seismic performance requirements and design criteria indicated.

C. Seismic Performance: Laboratory casework and support framing system, including attachments to other work, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

#### 1.5. ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, details, and attachments to other work.

1. Indicate locations of hardware and keying of locks.

2. Indicate locations and types of service fittings.

3. Indicate locations of blocking and reinforcements required for installing laboratory casework.

4. Include details of utility spaces showing supports for conduits and piping.

5. Include details of support framing system.

6. Include details of exposed conduits, if required, for service fittings.

7. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.

8. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Samples for Initial Selection: For factory-applied finishes and other materials requiring colour selection.

D. Samples for Verification: For each type of cabinet finish and each type of countertop material indicated, in manufacturer's standard sizes.

E. Samples for Verification: Unless otherwise directed, approved full-size Samples may become part of the completed Work, if in an undisturbed condition at time of Substantial Completion. Notify Architect of their



exact locations. If not incorporated into the Work, retain acceptable full-size Samples at Project site and remove when directed by Engineer.

1. One full-size, finished base cabinet complete with hardware, doors, and drawers.
  2. One full-size, finished wall cabinet complete with hardware, doors, and adjustable shelves.
  3. One Sample each of hinged and sliding doors.
  4. 6-inch- (150-mm-) square Samples for each type of countertop material.
  5. One of each service fitting specified, complete with accessories and specified finish.
  6. One of each type of sink and accessory item specified.
  7. One of each type of hardware item specified.
- F. Delegated-Design Submittal: For laboratory casework indicated to comply with seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.6. INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified manufacturer.
  - B. Product Test Reports for Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard and system structural performance specified in "Performance Requirements" Article.
  - C. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.
- 1.7. MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.
  - B. Furnish complete touchup kit for each type and colour of wood laboratory casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.
  - C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5% of amount installed, but no fewer than 20 of each type.
    2. Modular Countertop Units: Two extra units of each length and material installed.
- 1.8. QUALITY ASSURANCE
- A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8 and is certified for chain of custody by an FSC-accredited certification body.
  - B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.
    1. Obtain countertops, sinks, accessories and service fittings from casework manufacturer.

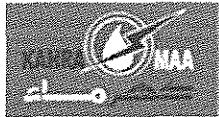


- C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalogue numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with the Specifications may be considered. Refer to Section 016000 "Product Requirements."
  - D. Retain first paragraph below for metal and wood laboratory casework only; plastic-laminate casework will not comply with referenced standard.
  - E. Casework Product Standard: Comply with SEFA 8, "Laboratory Furniture - Casework, Shelving and Tables - Recommended Practices."
  - F. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labelled as complying with requirements in NFPA 30 by a testing and inspecting agency acceptable to authorities having jurisdiction FM Approvals.
  - G. Electrical Components, Devices, and Accessories: Listed and labelled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - H. Keying Conference: Conduct conference at Project site.
  - I. Pre-installation Conference: Conduct conference at Project.
- 1.9. DELIVERY, STORAGE, AND HANDLING**
- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.
- 1.10. PROJECT CONDITIONS**
- A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- 1.11. COORDINATION**
- A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.
  - B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

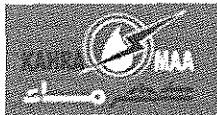
### **3.10.1.2 PART 2 – PRODUCTS**

#### **1.1. PLASTIC-LAMINATE CABINET MATERIALS**

- A. General:
  - 1. Certified Wood Materials: Provide cabinets with not less than 70% of all wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
  - 2. Adhesives: Adhesives shall not contain urea formaldehyde.
  - 3. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."



4. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  5. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core, unless otherwise indicated[, made without urea formaldehyde].
  6. MDF: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
  7. Particleboard: ANSI A208.1, Grade M-2.
  8. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde or straw-based particleboard complying with ANSI A208.1, Grade M-2, except for density, made with binder containing no urea formaldehyde.
  9. Hardboard: AHA A135.4, Class 1 Tempered.
  10. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
  11. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
  12. Edgebanding for Plastic Laminate: Plastic laminate matching adjacent surfaces.
  13. Colours: As selected by Engineer from manufacturer's full range.
  14. Edgebanding for Thermoset Decorative Panels: PVC or polyester edge banding complying with LMA EDG-1 and matching thermoset decorative panels.
- B. Exposed Materials:
1. Plastic Laminate: Grade HGS Grade HGL Grade VGS.
    - a. Colours: As selected by Engineer from manufacturer's full range.
- C. Semiexposed Materials:
1. Plastic Laminate: Grade VGS Grade CLS.
    - a. Colours: As selected by Engineer from manufacturer's full range.
    - b. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.
    - c. Provide plastic laminate for interior faces of doors and drawer fronts and where indicated.
  2. Thermoset Decorative Panels: Provide thermoset decorative panels for semiexposed surfaces unless otherwise indicated.
    - a. Colours: As selected by Engineer from manufacturer's full range.
  3. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects.
  4. Plywood: Hardwood plywood. Grade B Grade C faces and Grade J crossbands. Provide backs of same species as faces.
  5. Metal for Steel Drawer Pans: Cold-rolled, carbon-steel sheet complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.
- D. Concealed Materials:
1. Solid Wood: Any species, with no defects affecting strength or utility.
  2. Plywood: Hardwood plywood.
  3. Plastic Laminate: Type BKL.
  4. Particleboard.
  5. MDF.



6. Hardboard.
- 1.2. **AUXILIARY CABINET MATERIALS**
  - A. Acid Storage-Cabinet Lining: 1/4-inch- (6-mm-) thick, polyethylene, polypropylene, epoxy, or phenolic-composite lining material.
  - B. Glass for Glazed Doors: Clear laminated tempered glass complying with ASTM C 1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; with 2 lites not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.
  - C. Frameless Glass Doors: Clear tempered glass complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than [5.0] [6.0] mm thick; with exposed edges seamed before tempering.
- 1.3. **COUNTERTOP TABLE TOP SHELF TROUGH AND SINK MATERIALS**
  - A. Phenolic Composite: Solid, high-pressure decorative laminate, complying with NEMA LD 3, Grade CGS.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Trespa North America.
      - b. Epoxy Products.
      - c. Formica Corporation.
      - d. NuLab Furniture Corporation.
    2. Chemical Resistance: Composite countertop material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
      - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, formaldehyde (37 percent), furfural, hydrochloric acid (37 percent), hydrofluoric acid (48 percent), nitric acid (30 percent), phosphoric acid (85 percent), sodium hydroxide (20 percent), sulfuric acid (33 percent), toluene, and zinc chloride.
      3. Colour: As selected by Engineer from manufacturer's full range.
      4. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 Type 316L.
- 1.4. **PLASTIC-LAMINATE CABINETS**
  - A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.
  - B. Design: Flush overlay.
  - C. Construction: Provide plastic-laminate-faced laboratory casework of the following minimum construction:
    1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch- (19-mm-) thick particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
    2. Shelves: 3/4-inch- (19-mm-) thick thermoset decorative panels.
    3. Shelves: 3/4-inch- (19-mm-) thick particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
    4. Shelves: 3/4-inch- (19-mm-) thick plywood, plastic-laminate faced.



5. Backs of Cabinets: 1/2-inch- (12.7-mm-) thick particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
  6. Drawer Fronts: 3/4-inch- (19-mm-) thick particleboard, plastic-laminate faced.
  7. Drawer Sides and Backs: 1/2-inch- (12.7-mm-) thick solid-wood or veneer-core hardwood plywood thermoset decorative panels, with glued dovetail or multiple-dowel joints.
  8. Drawer Bottoms: 1/4-inch- (6.4-mm-) thick hardwood plywood thermoset decorative panels hardboard glued and dadoed into front, back, and sides of drawers. Use 1/2-inch- (12.7-mm-) thick material for drawers more than 24 inches (600 mm) wide.
  9. Drawer Bodies: Steel drawer pans formed from 0.036-inch- (0.91-mm-) thick metal, metallic phosphate treated, and finished with manufacturer's standard 2-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat and 2 mils (0.05 mm) for system.
  10. Doors 48 Inches (1200 mm) High or Less: 3/4 inch (19 mm) thick, with particleboard or MDF cores and solid-wood stiles and rails, plastic-laminate faced.
  11. Doors More Than 48 Inches (1200 mm) High: 1-1/16 inches (27 mm) thick, with honeycomb cores and solid hardwood stiles and rails, plastic-laminate faced.
  12. Doors More Than 48 Inches (1200 mm) High: 1-1/8 inches (29 mm) thick, with particleboard cores, plastic-laminate faced.
  13. Stiles and Rails of Glazed Doors[ 48 Inches (1200 mm) High or Less]: 3/4 inch (19 mm) thick, with particleboard cores, plastic-laminate faced.
  14. Stiles and Rails of Glazed Doors More Than 48 Inches (1200 mm) High: 1-1/16-inch- (27-mm-) thick, solid wood, plastic-laminate faced.
  15. Stiles and Rails of Glazed Doors More Than 48 Inches (1200 mm) High: 1-1/8 inches (29 mm) thick, with particleboard cores, plastic-laminate faced.
- D. Utility-Space Framing: Laboratory casework manufacturer's standard steel framing units consisting of 2 steel slotted channels complying with MFMA-4, not less than 1-5/8 inches (41 mm) square by 0.105-inch (2.66-mm) nominal thickness, and connected at top and bottom by U-shaped brackets made from 1-1/4-by-1-1/4-inch (32-by-6-mm) steel flat bars. Framing units may be made by welding specified channel material into rectangular frames instead of using U-shaped brackets.
- E. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.
1. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.
  2. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.
  3. Provide knee-space panels (modesty panels) at spaces between base cabinets, where cabinets are not installed against a wall or where space is not otherwise closed indicated. Fabricate from same material and with same finish as exposed cabinet backs.

#### 1.5. LABORATORY CASEWORK SYSTEM



- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1. Fisher Hamilton L.L.C.
    - 2. Kewaunee Scientific Corporation; Laboratory Product Group.
  - B. Provide casework manufacturer's standard integrated system that includes support framing, suspended modular cabinets, filler and closure panels, wall panels, undercabinet task-lighting fixtures, countertops, and fittings needed to assemble system. System includes hardware and fasteners for securing support framing to permanent construction.
    - 1. Cabinet Construction: Wood.
    - 2. Cabinets can be removed and reinstalled without use of special tools for relocation within system.
    - 3. Base cabinets can be removed without providing temporary support for, or removing, countertops.
    - 4. Sinks are supported independent of base cabinets.
    - 5. Support framing has provision for fastening pipe supports at utility space in not more than 1-inch (25-mm) increments.
    - 6. System includes filler and closure panels to close spaces between support framing, cabinets, shelves, countertops, floors, and walls unless otherwise indicated. Fabricate panels from same material and with same finish as metal cabinets and with hemmed or flanged edges.
  - C. Support Framing: Casework manufacturer's standard system consisting of vertical supports and connecting braces and rails as follows:
    - 1. Cabinets, shelves, and countertops are supported from vertical supports except where floor-supported base cabinets are indicated. Vertical positioning of supported cabinets, shelves, and countertops can be varied in 1-inch (25-mm) increments through full height of supports.
    - 2. Vertical supports rest on adjustable levelling bases and are secured to floor with metal clips fastened to floor.
    - 3. Vertical supports are installed with braces and rails connecting them to each other and to permanent building walls to create a stable, rigid structure with framed utility spaces where indicated.
    - 4. Vertical supports are braced at floor with cantilevered horizontal leg members where indicated.
  - D. Undercabinet Task-Light Fixtures: Single-tube fluorescent fixtures with switch and heavy-duty cord and plug.
    - 1. Finish: Baked enamel.
    - 2. Diffusers: Virgin acrylic with high resistance to yellowing and other changes due to aging, heat, and UV radiation.
    - 3. Ballast Sound Rating: A.
  - E. Countertops: Provide in modular lengths indicated, without seams.
- 1.6. METAL CABINET FINISH
- A. General: Prepare, treat, and finish welded assemblies after assembling. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.



- B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Chemical-Resistant Finish: Immediately after cleaning and pre-treating, apply laboratory casework manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
  - 1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
  - 2. Colours for Metal Laboratory Casework Finish: As selected by Engineer from manufacturer's full range.

## 1.7. HARDWARE

- A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Hinges: Stainless-steel, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches (1200 mm) high or less and 3 for doors more than 48 inches (1200 mm) high.
- C. Hinges for Wood and Plastic-Laminate Cabinets: Frameless concealed hinges (European type) complying with BHMA A156.9, Type B01602, 100 degrees of opening, self-closing.
- D. Hinged Door and Drawer Pulls: Solid stainless steel back-mounted pulls. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.
  - 1. Design: As selected from manufacturer's full range.
  - 2. Overall Size: As selected from manufacturer's full range.
- E. Sliding Door Pulls: Stainless-steel or chrome-plated recessed flush pulls.
  - 1. Design and Size: As selected from manufacturer's full range.
- F. Pulls: Recessed aluminium pulls. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.
- G. Pulls for Metal Cabinets: Full-width, recessed channel pulls; integrally formed from front pan of doors and drawer fronts.
- H. Pulls for Wood Cabinets: Full-width, recessed solid hardwood channels; matching exposed wood of cabinets.
- I. Pulls for Plastic-Laminate Cabinets: Full-width, recessed aluminium channel pulls.
- J. Door Catches: Dual, self-aligning, permanent magnet catches. Provide 2 catches on doors more than 48 inches (1200 mm) high.
- K. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.



1. Provide Grade 1HD-100; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
  2. Provide Grade 1HD-200; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
  3. Standard Duty (Grade 1): Full extension type, with polymer rollers.
  4. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Full -extension, ball-bearing type.
- L. Drawer Slides for Wood and Plastic-Laminate Cabinets: Hardwood runners under centres of drawers with polymer guides fastened to backs of drawers.
- M. Label Holders: Stainless steel, aluminium, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches (25 by 50 mm), attached with screws or rivets. Provide on all drawers.
- N. Locks for Metal Cabinets: Cam or half-mortise type with 5-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281, E07261, E07111, or E07021.
  1. Provide a minimum of two keys per lock and two master keys.
  2. Provide on all drawers and doors.
  3. Keying: Key locks alike within each room; key each room separately.
  4. Master Key System: Key all locks to be operable by master key.
- O. Locks for Wood and Plastic-Laminate Cabinets: Cam type with 5-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281 or E07261.
  1. Provide a minimum of two keys per lock and two master keys.
  2. Provide on all drawers and doors.
  3. Keying: Key locks within each room alike, key each room separately.
  4. Master Key System: Key all locks to be operable by master key.
- P. Sliding-Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding-door units.
- Q. Adjustable Shelf Supports for Wood and Plastic-Laminate Cabinets: Powder-coated steel shelf rests complying with BHMA A156.9, Type B04013.
- R. Adjustable Shelf Supports for Wood and Plastic-Laminate Cabinets: Mortise-type, powder-coated steel standards and shelf rests complying with BHMA A156.9, Types B04071 and B04091.
- S. Adjustable Wall Shelf Supports: Surface-type steel standards and steel shelf brackets, with epoxy powder-coated finish, complying with BHMA A156.9, Types B04102 and B04112.
- 1.8. COUNTERTOPS, TABLE TOPS , SHELVES , TROUGHS, AND SINKS
- A. Countertops, General: Provide units with smooth surfaces in uniform plane free of defects. Make exposed edges and corners straight and uniformly bevelled. Provide front and end overhang of 1 inch (25 mm), with continuous drip groove on underside 1/2 inch (13 mm) from edge.
  1. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Engineer.
    - a. Outlets: Provide with strainers and tailpieces, NPS 1-1/2 (DN 40), unless otherwise indicated.



- b. Overflows: For each sink except cup sinks provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches (50 mm) less than sink depth. Provide in same material as strainer.
- B. Phenolic-Composite Countertops Table Tops and Shelves:
  - 1. Countertop Fabrication: Fabricate with cutouts for sinks, holes for service fittings and accessories, and with butt joints assembled with epoxy adhesive and concealed metal splines.
    - a. Countertop Configuration: Flat, 3/4 inch (19 mm) thick, with beveled or rounded edge and corners, and with drip groove and integral coved backsplash.
    - b. Countertop Configuration: Raised (marine) edge, 3/4-inch (19-mm) minimum thickness, with beveled or rounded edge and corners, and with integral coved backsplash.
    - c. Countertop Configuration: As indicated.
  - 2. Table-Top Fabrication:
    - a. Table-Top Configuration: Flat, 3/4 inch (19 mm) thick, with beveled or rounded edge and corners, and with drip groove at perimeter.
    - b. Table-Top Configuration: Raised (marine) edge, 3/4-inch (19-mm) minimum thickness, with integral or applied raised edge having beveled or rounded edge and corners.
  - 3. Shelf Configuration: Flat, 3/4 inch (19 mm) thick, with beveled or rounded edge and corners.
- C. Stainless-Steel Countertops: Made from stainless-steel sheet, not less than 0.062-inch (1.59-mm) nominal thickness, with No. 4 satin finish.
  - 1. Extend top down 1 inch (25 mm) at edges with a 1/2-inch (13-mm) return flange under frame. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
  - 2. Form backsplash coved to and integral with top surface.
  - 3. Provide raised (marine) edge around perimeter of countertops containing sinks; pitch two ways to sink to provide drainage without channelling or grooving.
  - 4. Provide raised (marine) edge around perimeter of countertops at sinks, where indicated; pitch two ways to sink to provide drainage without channelling or grooving.
  - 5. Punch holes for service fittings at factory.
  - 6. Reinforce underside of countertop with channels or use thicker metal sheet where necessary to insure rigidity without deflection.
  - 7. Weld shop-made joints.
  - 8. Where field-made joints are required, provide hairline butt-joints mechanically bolted through continuous channels welded to underside at edges of joined ends. Keep field jointing to a minimum.
  - 9. Where stainless-steel sinks or cup sinks occur in stainless-steel countertops, factory weld into one integral unit.
  - 10. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
- D. Stainless-Steel Shelves: Made from stainless-steel sheet, not less than 0.050-inch (1.27-mm) nominal thickness, with No. 4 satin finish. Weld shop-made joints. Fold down front edge 3/4 inch (19 mm); fold up back edge 3 inches (75 mm). Provide integral stiffening brackets, formed by folding up ends 3/4 inch



- (19 mm) and welding to upturned front and back edges. After fabricating, grind welds smooth and polish as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
- E. Stainless-Steel Sinks: Made from stainless-steel sheet, not less than 0.050-inch (1.27-mm) nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch (16-mm) radius. Slope sink bottoms to outlet. Provide double-wall construction for sink partitions with top edge rounded to at least 1/2-inch (13-mm) diameter. Provide continuous butt-welded joints. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
- F. Punch holes for fittings at factory.
5. Provide with stainless-steel strainers and tailpieces.
  6. Provide with integral rims except where located in stainless-steel countertops.
  7. Apply 1/8-inch- (3-mm-) thick coating of heat-resistant, sound-deadening mastic to undersink surfaces.
- G. Cup Sinks: Stainless steel, 3-by-9-inch (75-by-228-mm) oval 5-inch (127-mm) diameter.
1. Provide with stainless-steel strainers and integral tailpieces.
- H. Cup Sinks: Material and size as indicated.
1. Provide epoxy and polypropylene cup sinks with polypropylene strainers and integral tailpieces.
  2. Provide stainless-steel cup sinks with stainless-steel strainers and integral tailpieces.
- I. Troughs: Epoxy or stainless steel, as indicated. Pitch to drains not less than 1/8 inch/foot (10 mm/m). Except where troughs empty into sinks, provide NPS 1-1/2 (DN 40) outlets with strainers and tailpieces.
1. Epoxy Troughs: Molded in 1 piece with smooth surfaces and coved corners; 3/4-inch (19-mm) minimum thickness. Provide polypropylene strainers and tailpieces.
  2. Stainless-Steel Troughs: Made from stainless-steel sheet, not less than 0.062-inch (1.59-mm) nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch (16-mm) radius. Provide continuous butt-welded joints. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean. Provide stainless-steel strainers and tailpieces.
- 1.9. LABORATORY ACCESSORIES
- A. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop, unless otherwise indicated.
- B. Burette Rods: Aluminium or stainless-steel rods, 1/2 inch (13 mm) in diameter and 18 inches (450 mm) long, threaded on 1 end to fit tapered plug adapter for flush socket receptacle. Provide with tapered plug adapter and receptacle.
- C. Upright Rod Assembly and Metal Crossbar: Aluminium or stainless steel. Two vertical rods and 1 horizontal crossbar, 3/4 inch (19 mm) in diameter and 36 inches (900 mm) long, unless otherwise indicated; 2 flush socket receptacles and 2 crossbar clamps. Ends of vertical rods are tapered to fit receptacles; all other rod ends are rounded.



- D. Greenlaw Arm Assembly: Aluminium or stainless-steel vertical rod, tapered on one end to fit flush socket receptacle. Adjustable crossbar of hardwood with black, acid-resistant finish, secured to upright with adjustable clamp. Provide with receptacle.
- E. Lattice Assembly: Aluminium or stainless-steel, vertical and horizontal rod lattice assembly with 3/4-inch-(19-mm-) diameter rods at approximately 12 inches (300 mm) o.c. with 2 flush socket receptacles for mounting.
  - 1. Size: 48 inches (1200 mm) wide by 36 inches (900 mm) high.
- F. Pegboards: Polypropylene, epoxy, or phenolic-composite pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.
- G. Pegboards: Stainless-steel pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

#### 1.10. WATER AND LABORATORY GAS SERVICE FITTINGS

- A. Manufacturers: As selected by Contractor
  - 1. Service Fittings: Provide units that comply with SEFA 7, "Laboratory and Hospital Fixtures – Recommended Practices." Provide fittings complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
  - 2. Provide units that comply with "Vandal-Resistant Faucets and Fixtures" recommendations in SEFA 7.
- B. Materials: Fabricated from cast or forged red brass unless otherwise indicated.
  - Reagent-Grade Water Service Fittings: Polypropylene, PVC, or PVDF for parts in contact with water.
- C. Finish: Acid- and solvent-resistant powder coating complying with requirements in SEFA 7 for corrosion-resistant finishes.
- D. Provide chemical-resistant powder coating in laboratory casework manufacturer's standard metallic brown, aluminium, white, or other colour as approved by Architect.
- E. Water Valves and Faucets: Provide units complying with ASME A112.18.1, with renewable seats, designed for working pressure up to 80 psig (550 kPa).
  - 1. Vacuum Breakers: Provide ASSE 1035 vacuum breakers on water fittings with serrated outlets.
  - 2. Aerators: Provide aerators on water fittings that do not have serrated outlets.
  - 3. Self-Closing Valves: Provide self-closing valves where indicated.
- F. Ground-Key Cocks: Tapered core and handle of one-piece forged brass, ground and lapped, and held in place under constant spring pressure. Provide units designed for working pressure up to 40 psig (280 kPa), with serrated outlets.
- G. Ball Valves: Chrome-plated ball and PTFE seals. Handle requires no more than 5 lbf (22 N) to operate. Provide units designed for working pressure up to 75 psig (520 kPa), with serrated outlets.
  - 1. Where ball valves are indicated for fuel-gas use, provide locking safety handles that must be pushed in or pulled up before being turned on unless otherwise indicated.
- H. Steam Valves: Stainless-steel seat and PTFE seat disc. Provide units designed for steam working pressure up to 20 psig (140 kPa), with serrated outlets.



- I. Needle Valves: Provide units with renewable, self-centering, floating cones and renewable seats of stainless steel or Monel metal, with removable serrated outlets.
  - J. Hand of Fittings: Furnish right-hand fittings unless fitting designation is followed by "L."
  - K. Remote-Control Valves: Provide needle valves, straight-through or angle type as indicated for fume hoods and where indicated.
  - L. Handles: three- or four-wing, molded plastic or powder-coated metal handles for valves unless otherwise indicated.
    - 1. Provide lever-type handles for ground-key cocks. Lever handle aligns with outlet when valve is closed and is perpendicular to outlet when valve is fully open.
    - 2. Provide lever-type handles for ball valves unless otherwise indicated. Lever handle aligns with outlet when valve is closed and is perpendicular to outlet when valve is fully open.
    - 3. Provide heat-resistant plastic handles for steam valves.
    - 4. Provide knurled, molded plastic handles for needle valves.
  - M. Service-Outlet Identification: Provide color-coded plastic discs with embossed identification, secured to each service-fitting handle to be tamper resistant. Comply with SEFA 7 for colours and embossed identification.
- 1.11. ELECTRICAL SERVICE FITTINGS
- A. Service Fittings, General: Provide units complete with metal housings, receptacles, terminals, switches, pilot lights, device plates, accessories, and gaskets required for mounting on laboratory casework.
  - B. Receptacles: Comply with NEMA WD 1, NEMA WD 6, and UL 498. Duplex type, Configuration 5 20R.
    - 1. Colour of Receptacles: As selected by Engineer unless otherwise indicated or required by NFPA 70.
  - C. Switches: Comply with NEMA WD 1 and UL 20. Provide single-pole, double-pole, or 3-way switches as required; rated 120 to 277-V ac; and in amperage capacities to suit units served.
    - 1. Colour of Switches: As selected by Engineer unless otherwise indicated or required by NFPA 70.
    - 2. Provide pilot light adjacent to switch or neon-lighted handle, illuminated when switch is "ON," where noted as "PL" next to switch identification.
    - 3. Provide key-operated switch where noted as "KEY" next to switch identification.
    - 4. Provide thermal-overload switches, single or double pole, as required, with maximum overcurrent trip setting to suit particular motor controlled.
  - D. Pedestal-Type Fittings: Cast-aluminium housings with sloped single face or two faces, as indicated, with neoprene gasket under base and with concealed mounting holes in base for attaching to laboratory casework. Provide holes tapped for conduits.
  - E. Line-Type Fittings: Provide with cast-metal boxes with threaded holes for mounting on rigid steel conduit. Provide cover plates same size as boxes.
  - F. Recessed-Type Fittings: Provide with galvanized-steel boxes.
  - G. Finishes for Service-Fitting Components: Provide housings or boxes for pedestal- and line-type fittings with manufacturer's standard baked-on, chemical-resistant enamel in colour as selected by Engineer from manufacturer's full range.
  - H. Cover Plates: Provide satin finish, Type 304, stainless-steel cover plates with formed, bevelled edges.



- I. Cover-Plate Identification: Use 1/4-inch- (6-mm-) high letters unless otherwise indicated. For stainless steel or chrome-plated metal, stamp or etch plate and fill in letters with black enamel.
  1. Provide on all cover plates.
  2. Provide the following information:
    - a. Voltage and phase for receptacles other than standard 125-V duplex, grounding type.
    - b. Indicate equipment being controlled by switches and thermal-overload switches.
    - c. Indicate equipment being controlled for pilot lights when located remotely from associated equipment or switch, where function is not obvious.
    - d. Number of breaker in panelboard that controls device.

### **3.10.1.3 PART 3 – EXECUTION**

#### **1.1. EXAMINATION**

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of laboratory casework.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **1.2. INSTALLATION OF CABINETS**

- A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
  1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet (1.5 mm in 3 m).
  2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet (3 mm in 3 m).
  3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet (3 mm in 3 m).
  4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
  5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.5 mm).
- B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.
- C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
  1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches (600 mm) o.c. and at sides of cabinets with not less than 2 fasteners per side.
- D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches (600 mm) o.c.
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- F. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

#### **1.3. INSTALLATION OF COUNTERTOPS**



- A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.
  - B. Field Jointing: Where possible, make in same manner as shop-made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Prepare edges in shop for field-made joints.
    - 1. Use concealed clamping devices for field-made joints in plastic-laminate countertops. Locate clamping devices within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints.
  - C. Fastening:
    - 1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
    - 2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches (1200 mm) o.c.
    - 3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch (3 mm) and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.
  - D. Provide required holes and cutouts for service fittings.
  - E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.
  - F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
  - G. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- 1.4. INSTALLATION OF SINKS**
- A. Comply with installation requirements in SEFA 2.3.
  - B. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table- and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.
  - C. Semiflush Installation of Stainless-Steel Sinks: Before setting, apply sink and countertop manufacturers' recommended sealant under rim lip and along top. Remove excess sealant while still wet and finish joint for neat appearance.
  - D. Drop-in Installation of Epoxy Sinks: Rout groove in countertop to receive sink rim if not prepared in shop. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.



- E. Drop-in Installation of Epoxy and Polypropylene Cup Sinks: Rout groove in countertop to receive sink rim if not prepared in shop. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.
  - F. Surface Installation of Epoxy and Polypropylene Cup Sinks: Set sink in sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.
- 1.5. **INSTALLATION OF LABORATORY ACCESSORIES**
- A. Install accessories according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions.
  - B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.
  - C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.
  - D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.
- 1.6. **INSTALLATION OF SERVICE FITTINGS**
- A. Comply with requirements in other Sections for installing water and laboratory gas service fittings and electrical devices.
  - B. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.
- 1.7. **CLEANING AND PROTECTING**
- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Engineer.
  - B. Protect countertop surfaces during construction with 6-mil (0.15-mm) plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches (1200 mm) o.c.



### **3.11 DIVISION 14 CONVEYING**

#### **3.11.1 SECTION 14 20 00 ELEVATOR PERFORMANCE SPECIFICATIONS**

Conveyer system has been designed and coordinated as per Manufacturer:

KONE Elevators LLC  
PO box 37143 Doha  
Tel: +974 455 2150 / +974 455 1409  
Fax: +974 455 2403

The contractor may propose alternative products within this specification which are equal to and approved by the Engineer.

#### **LIFT MATRIX**

	<b>Goods Lifts</b>
<b>Area/Grid Line</b>	Grid L.2, 1.1
<b>Type</b>	Goods
<b>Lift No.</b>	GL1
<b>Quantity</b>	1
<b>Capacity(Kgs.)</b>	2500
<b>Stops</b>	4
<b>Openings</b>	As Per General Arrangement Plans
<b>Travel(m)</b>	-
<b>Floors served</b>	As Per General Arrangement Plans
<b>No. of car doors</b>	1
<b>Speed (m/s)</b>	1.6
<b>Operation control</b>	G1C
<b>Machine location</b>	Machine Room-Less
<b>Shaft size mm)</b>	3000X3300
<b>Car size wxd(mm)</b>	1800x2700
<b>Door size (mm)</b>	2300x1400
<b>Door type</b>	Single Entry Car
<b>Pit depth(mm)</b>	Min. 1400
<b>Overhead(mm)</b>	4100
<b>Car Clear Height(mm)</b>	2300
<b>Motor power (kW)/unit</b>	-

#### **PARTICULAR TECHNICAL SPECIFICATIONS FOR LIFTS**

##### **Standard compliance:**

Latest applicable parts of EN81.



**Door sill:**

Extruded hard aluminium.

**Door safety edge:**

Electronic non-contact safety edge.

**Door operator:**

As per Manufacturer's Requirements

**Door Architrave:** Asturias Stainless Steel

**Cabin finish:**

**Goods Lift:** Flemish Linen

**Passengers Lift:** Asturias Stainless Steel

**Front return:** Asturias Stainless Steel

**Cabin door:**

**Goods Lift:** Flemish Linen

**Passengers Lift:** Asturias Stainless Steel

**Landing door:**

**Goods Lift:** Flemish Linen. GL2 at Ground Floor – Spanish Anthracite

**Passengers Lift:** Asturias Stainless Steel

**Handrail (Passengers Lift):**

HR41 Asturias Satin Stainless Steel

**Flooring:**

Composite Stone

**Ceiling:**

Type LF53

**Car operating panel:** KSS 570

**Incorporates:**

LED position indicator, direction and over load indicators, alarm, door open/close buttons, illuminated floors buttons, 2 way microphone/ speaker intercom system.

**Hall position indicator:** KSS 570

Integrated hall position indicator with hall buttons at all floors.

(Faceplate in hairline stainless steel).

**Hall buttons:** KSS 570

Illuminated push buttons at all floors.

**Hoist way door finish:**

Asturias Satin Stainless Steel

**Safety:**

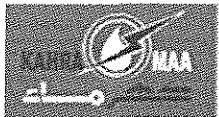
Progressive safety device to stops the lift within 560mm.

**Buffers:**

Polyurethane /oil buffers under cabin and counter weight.

**Power supply:**

3-phase 400 volts AC, 50 Hz. To be confirmed by Manufacturer



**Maintenance Access Panel:**

At Last Level Served

**STANDARD FEATURES**

Fireman emergency operation.

Car arrival gong at all landings to indicate the arrival of the lift cabin to any particular floor.

Emergency unlocking device to enable opening of any landing door for emergency evacuation. Fan with key switch.

Door nudging feature: If the doors remain open for longer than the pre-set period; a temporary override with audible indication automatically closes the doors.

Emergency evacuation device: battery backed emergency landing device, to take the lifts to the nearest floor in case of power failure.

**GENERAL PERFORMANCE SPECIFICATIONS AND CODE COMPLIANCE FOR LIFTS**

**GENERAL REQUIREMENTS**

**EXTENT OF WORK:**

The Contract includes the supply, delivery, erection, connection, testing and servicing of all materials and equipment required to provide the scheduled lifts in the stated building(s), all in accordance with the terms and conditions of the attached Preliminaries, Specifications and Schedules.

The Contract shall include all necessary attendance by other trades, specialist sub-contractors and suppliers, the proper co-ordination of all services to be installed in the Building(s) and the arranging with other trades for all conduit, cable routes, positions of switchgear, accessories, etc. All notices, whether statutory or not, required to be issued or given for the satisfactory completion of the work, shall be attended to as part of this Contract, and any costs expendable in connection with the issue or giving of such notices shall be deemed to have been included.

This Specification shall be deemed to be a guide as to the quality of materials and standard or workmanship required and all necessary materials and equipment required to be provided for the lifts described in the following clauses of this Specification shall be included in the Contract. In order to avoid misinterpretation, any doubts regarding the full extent of this Specification or accompanying drawings shall be resolved prior to the completion of the Tender.

**STANDARDS:**

The whole of the work and materials to be supplied shall be to the requirements of the Local Statutory Bodies and of the Health and Safety at Work etc. Act 1974 and shall also be in accordance with the following British Standard Publications where applicable:-

B.S. 5655 Parts 1, 2, 3, 5, 6, 7, 8, 9, 10, 11 and 12 \_Lifts and service lifts\_

B.S. 7255 Safe working on lifts

B.S. 302 Stranded steel wire ropes Part 4 – \_Specification for ropes for lifts\_ and Apparatus on the Basis of Thermal Stability in Service'.

B.S. 4568 Steel Conduit and Fittings with Metric Threads of I.S.O. form for Electrical Installations.

B.S. 4678 Part I – 'Steel Surface Trunking'.

B.S. 5000 Part 99 – Machines for miscellaneous applications

B.S. 5588 Part 5 – Code of practice for fire-fighting stairways and lifts

B.S. 6004 PVC Insulated Cables' (Non-Armoured for Electric Power and Lighting).

B.S. 6977 Braided Travelling Cables for Electric and Hydraulic Lifts'.

B.S. 7671 Regulations for Electrical Installations'. (Previously known as the IEE Regulations)



**Qatar General Electricity & Water Corporation**  
**Tender No. GTC 626/2014**  
**Construction of Mega Reservoirs PRPSs**  
**(Package A, B, C, D & E)**

When no reference is made to any of the lift components, then the British Standard

Specification No. 5655 shall apply without qualification.

Each standard shall be that edition, complete with any amendments, current at the date of Tender.

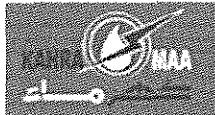
**DRAWINGS TO BE INCLUDED IN THIS CONTRACT:**

- It should be noted that the lift drawings are in general diagrammatic and have been prepared together with the Specification, to demonstrate principles and to enable comparative Tenders to be obtained.
- On appointment of the Contractor the latest architectural drawings shall be obtained.
- These drawings shall then be used as the basis for installation drawings, which shall be prepared and issued by the Contractor in accordance with the requirements of the building construction programme.
- Certain advance details of the builders work may have already been agreed by the Engineer and will either be detailed in the Specification or on the Tender drawings, but it is the Contractor's responsibility to ensure that these details are correct and sufficient for his work.
- The following drawings shall be provided by the Contractor and shall form the Contract drawings and shall be duly co-ordinated with other work to be installed:
  - Detailed layout drawings of all equipment
  - Detail plant room drawings
  - Detail plans, elevations, etc. of the lift car, showing finishes.
  - Any drawings the Contractor intends using as installation drawings.
  - Detailed plans, sections and elevations, showing all required builders work, including size and position of all holes, chases and steelwork.
  - Any details drawings or manufacturer's drawings required prior to, or found necessary during erection, manufacture, or progress.
  - Four preliminary copies (or other quantity as may be identified in any contract documentation) of these drawings shall be forwarded to the design team.
- The design team shall then approve or comment upon the drawings and return a master copy to the Lift Contractor for revision.
- After revision the Contractor shall supply the required number of Contract drawings for general issue, unless the review process required re-submission. In this case, the procedure outlined above shall be followed until the drawings are acceptable for issue.
- The Contractor's programme shall allow adequate time for the review, together with an allowance for correction and resubmission of the drawings.

**APPROVAL OF DRAWINGS/ INFORMATION:**

- All drawings, schedules or other information provided by manufacturers, nominated suppliers or specialist Sub-Contractor shall be approved by the Contractor and such approval shall ensure that all requirements of the contract documentation have been incorporated.
- When this procedure has been completed, the Contractor shall forward two paper prints of the approved drawings or two copies of the approved schedules or other information to the Engineer for record purposes.
- No order to a manufacturer, nominated supplier, or specialist Sub-Contractor, to commence manufacture/installation shall be given until written acknowledgement of receipt by the Engineer of the above information, has been received by the Contractor.
- Any costs arising from failure to meet the above conditions shall be borne by the Contractor at no cost to the Client/Owner.

**TECHNICAL DEVIATIONS AND ALTERNATIVES:**



- It is appreciated that the lift manufacturer may have standard or alternative components which he may wish to be offered for consideration. It is therefore permitted to state on the tender returns any components which the manufacturer may wish to offer as an alternative to this Contract Specification, together with the cost effect. The declared tender shall be based on this specification.
- Should the manufacturer be compelled to deviate from the Specification then the deviation shall be clearly stated on the Schedule and the cost of the alternative shall be included in the Contract Sum.
- In any alternatives offered would result in a change to the Contract Sum, then the addition or reduction in cost to the Contract Sum must also be stated on the return.
- Any alternative offered shall not form part of this Contract unless authorised by the Engineer, and no alternative which is not stated on the Schedule will be considered, even though it may be mentioned in a covering letter or any other document sent with the offer.

**SPECIAL INSPECTION MEETINGS WITH ENGINEER:**

- At an appropriate stage in the completion of the works a qualified senior representative shall attend a series of special meetings with the Engineer to which the Engineer will be invited. The meetings may be held at approximately fortnightly intervals and their purpose will be to ensure that all outstanding works are properly finished and commissioned prior to the handover to Kahramaa.

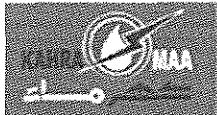
**PROTECTION OF PLANT AND EQUIPMENT:**

- The Contract shall include for the protection of all items of plant and equipment from damage by other trades on site and from all climatic conditions that may be experienced during delivery, storage on site, erection and up to the time that the building is handed over. The protection shall include the following minimum requirements in addition to the standard conditions relating to protection.
- Factory finished cubicles such as controllers, selector panels, etc., shall have all top and side edges protected with timber battens forming angle sections with industrial felt or similar packing between the timber and the panel. The protective angles shall be cross braced with further timber battens to form an open crate with additional protection over any particular fragile sections, e.g. instruments, indicator panels, etc. In addition a strong transparent plastic sheet or bag of not less than 500 gauge thickness shall be arranged between the panel and the protective timber to provide a damp and dust resistant membrane.
- Electric motors, hoisting ropes, loose well equipment and the like shall be protected by a plastic sheet or bag of the quality described above to prevent contamination by dust, debris, etc. Particular attention shall be paid to items having a protective covering or dressing that is likely to retain dust, etc.
- All stainless steel finishes shall have a PVC protective wrapper which shall be retained until handover.
- Where it is necessary to partly or completely remove any protection for installation or making connections to the equipment, the protection shall be reinstated to the standard specified immediately the operation is completed.
- All bright parts of the equipment that are liable to rust shall be covered with tallow or equivalent for protection during storage and erection. Upon completion this coating shall be cleaned off and the parts polished.
- Any equipment or material that has in the opinion of the Engineer been damaged or contaminated to the detriment of the finished installation shall be removed from site and replaced at no extra charge to the Contract and without effect to the programme.

**SAMPLES:**

The Contract shall include the provision of samples of finishes as may be required, properly labelled, of all landing pushes, landing indicators, panels, etc. or other items of equipment described in this Specification.

The samples shall be submitted to the Engineer as soon as possible after the Contract has been placed in order that the subsequent delivery of the associated equipment will not be delayed.



Unless otherwise stated, approved samples shall be retained on site by the Engineer, who will reject all such materials which do not correspond with the approved samples.

Rejected materials shall be removed from site immediately.

The Engineer shall be at liberty to reject any such materials after delivery should he consider them to be in any way unsatisfactory. All samples may be retained at the end of the Contract period.

**FINAL INSPECTION, TESTING AND COMMISSIONING:**

The Contract shall include witnessed inspection, testing and general commissioning as specified in B.S. 5655, which shall be separate from the Contractor's own testing and witnessed by the Engineer. These tests shall be made prior to handing-over at the practical completion stage and any defects found shall be corrected immediately.

The Contract shall include the provision of all instruments, test weights etc. for carrying out the tests.

Fourteen days' notice in writing of the dates proposed to carry out these tests shall be given to the Engineer after completion of installation of all lifts.

The Contract shall include the provision of duplicate certificates of test and including the examination report of motors and suspension ropes.

Before the final tests are witnessed by the Engineer, such checks and assessments shall be conducted to ensure that when the final tests are conducted they can be carried out with reasonable anticipation that the requirements of the Contract will be met and the final tests can be concluded without interruption and postponement.

The Contract shall be deemed to include for any stand-still (Caretaker) maintenance visits considered necessary in the event of the testing and commissioning being carried out in excess of one month prior to the Overall Practical Completion of the Main

Contract. Alternatively, this Contract shall be deemed to include for a return visit to site or the testing and commissioning in the event of this period being programmed to occur sometime after completion of the installation of the lift(s). This is considered necessary to afford Kahramaa the full benefit of the contract maintenance and of a lift installation in perfect working order and thus the omission of this aspect will not be accepted.

**NOTICES, NAMEPLATES AND TOOLS:**

The Contract shall include the supply and/or fixing of the following:-

A notice on the outside of the lift motor room door worded as follows with characters not less than 13mm high 'DANGER LIFT MACHINERY. UNAUTHORISED ACCESS PROHIBITED. DOOR TO BE KEPT LOCKED'.

A framed and glass covered full connection diagram, or a diagram encapsulated in clear plastic, fixed in the motor room and arranged to 'stand-off' the wall.

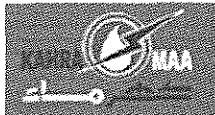
Clearly illustrated emergency and/or operating instructions fixed adjacent to each lifting motor, brake, etc.

Electric shock treatment notice fixed in the motor room.

Maker's name and load plated fixed in the lift car. This plate shall indicate the load in kilograms, the passenger complement for full load, and the lift designation.

Three copies (or other quantity as may be identified in any relevant Contract documentation) of a service manual covering all items of plant and ancillary equipment including:

- a. Index to contents.
- b. Description and design intent.
- c. Detailed emergency procedures (to be clearly identified in the index).



- d. Procedures and recommended materials for any cleaning that should be carried out by the Client or users.
- e. Lubrication details and summary of procedure.
- f. Planned maintenance procedure.
- g. Operational routine.
- h. Line diagrams.
- i. Schedule of electrical equipment.
- j. Manufacturer's service manuals.
- k. Complete spares list.
- l. Spares ordering instructions.
- m. Vocabulary
- n. One copy of all relevant test certificates.

A purpose designed rack fixed on the machine room wall to which shall be fixed, when applicable, the hand winding wheel, the brake release key, door release key etc.

Any other tools necessary for emergency use of the lift shall also be fixed to this rack. Each individual item shall be suitably labelled on the tool board for ease of identification.

#### **RECORD DRAWINGS:**

The drawings shall be as follows:-

General arrangement of machine room lift equipment as actually installed, including circuit breakers, isolators, car lighting switch etc.

General arrangement of equipment in the well.

Wiring diagram giving full details of all electrical equipment as actually wired and installed. The marking of all terminals on equipment shall be clearly carried out, and these markings shall correspond to the connections on the wiring diagrams, which shall also be clearly indicated.

Two preliminary paper prints of these drawings shall be submitted to the Engineer for approval before the final copies are printed. Stencils shall be used for all printing on drawings. The drawings shall be a scale not less than the Tender drawings.

A spare set of working drawings shall be kept on site in order that positions of equipment etc. can be checked during the Engineer routine visits and an accurate and comprehensive record can be maintained of the installation.

All the foregoing drawings shall be specially prepared and the final copies shall, unless identified differently in any Contract documentation, consist of one 35mm negative aperture card, one heavy plastic film negative and two high quality paper prints of each drawing.

The Contract shall include all associated costs for providing the above record drawings and these shall be to the reasonable satisfaction of the Engineer.

It shall be especially noted that, as a result of the Provisions of the Health and Safety at Work Act, Kahramaa will not accept handover of the installations until full information concerning the installation is in the possession of his operational and maintenance staff and therefore any Certificate of Practical Completion cannot be issued until the Record Drawings are available.

#### **MAINTENANCE DURING DEFECTS LIABILITY PERIOD:**

The Contract shall include the provision of a fully comprehensive maintenance on the completed lift installation for a period of twelve months from the date of Overall Practical Completion of the Main Contract for the particular building.



Maintenance shall be carried out as necessary during the 12 month period and shall include the cleaning, oiling, greasing and adjustments of all parts of the lift and to maintain as far as possible the accuracy of operations as stated in this Specification.

During the initial 12 month maintenance period, the Contract shall include the making good or replacing of any part that shall be found to be defective, or show any signs of weakness or undue wear in consequence of faulty design, workmanship or material.

The lift motor room and pit, floors and walls shall be kept free of oil, grease and rubbish and shall be left in a tidy manner after maintenance.

When the lift is not available for use while being maintained, a suitable notice shall be displayed at each entrance to the lift indicating that it is temporarily out-of-service.

All lamps in the indicators and in car and shaft lighting luminaires that are found to be defective at the time of inspection shall be renewed.

The Contract shall include for the provision of Service Engineers to answer any breakdown calls between 7.00 am and 7.00 pm during the twelve month period. If stated in the Schedule of Particulars, the breakdown service shall be extended to 24 hours. The engineer(s) shall be on site within 1 hour of the call-out placement.

A logbook shall be provided for each lift to record maintenance visits, inspections, breakdowns, repairs, etc. this being retained in the relevant lift motor room unless otherwise directed. A full report shall be submitted to the Client as soon as possible following service visits identifying:

- Date of visit.
- Faults found
- Work carried out.
- Any work carried out during intermediate visits.

#### **COMPREHENSIVE MAINTENANCE AND SERVICING:**

A Schedule indicating the annual charge based on a 3-year period per lift for comprehensive maintenance as detailed below shall be completed.

Routine examination of the entire lift equipment. The cost of repair or replacement of any component parts of the lift installation.

The cost of the service to be based on the work being carried out during normal working hours unless stated otherwise in the attached Schedule of Lift Particulars, and all possible care shall be taken to ensure that the lifts are maintained in proper and safe working order.

The service cost shall include for all necessary call-outs during normal working hours unless otherwise stated. A full description of everything included in the standard form of comprehensive maintenance agreement shall be included. This cost shall not be included in the Tender sum.

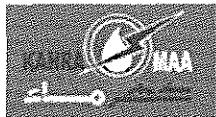
#### **GENERAL TECHNICAL REQUIREMENTS**

##### **BUILDERS WORK:**

The following Builders work will be carried out by the Contractor and the cost of these works shall be included in the Contract. Full details shall be provided to enable these works to proceed according to the Overall Contract Programme.

Builders work generally in cutting away and making good to walls and masonry including repairs to plaster, grouting in of fixing bolts, all chases and openings as required.

The provision of efficient temporary guards or screens at each landing opening as required until the permanent doors are fixed in position. The Contractor shall be responsible for reinstatement of the protection where this needs removal for access to the well or part thereof.



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The clearance of all debris from a central, agreed point. The Contract shall include for the clearing away of all debris occasioned from the well and machine room to the agreed central point.

The Contract shall include for the supply and installation of temporary lighting to the lift well, from a 220v supply, local to the area of works.

The specialist Contractor shall include for on-site drilling and provision of anchor bolts or similar, following acceptance by the Structural Engineer of the size and type of bolt to be used, for all fixings in the well.

The Contractor shall include for site measurement of the threshold detail to ensure compatibility with the unit to be supplied and installed under this Contract.

The Contract shall include the provision of any scaffolding required in the lift well(s) or motor rooms(s) for installation of the equipment for the period necessary for the works.

The Contractor shall include for any steelwork in the well or machine room considered necessary for the installation or on-going maintenance of his lift, equipment (e.g. lifting beams).

**STEELWORK AND PAINTING:**

The Contract shall include the supplying and fixing of any bed-plates for the motive power unit, together with all steelwork to carry the ropes, sheaves, buffers and the complete power unit assembly as applicable.

The Contract shall include the supply and fixing of all guides and necessary steelwork for guide fixings, landing sills, door tracks and buffers. The supply and installation of fascia panels, toe-guards, rope hole reducing covers to holes through slabs, permanent pit access ladders and fire resisting panels to reduce shaft or sheave holes through motor room / well walls and any access ladders or guard rails to lift equipment shall be included.

The Contractor shall apply two coats of paint before erection and one finish coat of paint after erection to all steelwork on the outside of the lift car and to all structural steelwork installed under this Contract within the lift well and machine room. Steelwork which will be inaccessible after erection shall be painted with the third coat before installation.

Machinery such as motors, gearboxes, controllers etc. shall be cellulosed with a minimum of 3 coats (one primer and two top coats).

Traction sheaves, integral winding wheels, brake drums and any similar smooth rotating parts shall be painted yellow, at least in part.

**LOADING:**

The maximum contract load for each lift shall be as indicated in the attached Schedule and load and data plates / indication shall be fitted within the lift car in accordance with B.S. 5655 Part I.

The load plates shall indicate the maximum loading in kg. and number of persons for each lift and shall be manufactured from stainless steel with the lettering engraved. The character sizes shall be in accordance with the requirements of B.S. 5655.

All lettering and numerals shall be in the national language of the country of installation. Each lift car shall be fitted with a proven load weighing device or system to render the lift inoperative should the contract load be exceeded. Normal operation shall be resumed on removal of the overload. Visual indication of overload, together with an audible warning sounder shall be fitted within the car.

**GUIDES:**

The guides for the car and counterweight shall be planed steel tees, erected plumb and securely fixed to the walls by heavy steel brackets.

The ends shall be tongued and grooved, forming matched joints and shall be connected by steel plates. Guide lengths shall be selected and installed such that joints do not coincide when the car is at any position in the well.

Guide brackets shall be located to B.S. 5655 requirements.



All guides shall be complete with oil trays at pit slab level.

**GUIDE SHOES:**

Sliding type guide shoes may be used to lift cars and counterweights where the contract speed does not exceed 1.6m/s unless otherwise called for in the detailed section of this specification or in the schedules.

Roller type guide shoes with rubber or neoprene tyres shall be used for lifts with contract speeds in excess of 1.6 m/s

The sliding guide shoes shall utilise renewable liners, those for the car being self-adjusting. Where metal inserts are used, wick-fed oil lubricators with felt wipers shall be incorporated.

The design for roller guide shoes shall include guard plates to prevent finger traps between the rollers and guide faces. Also included shall be metal retainers to ensure that the frame assembly will not move from its normal running position in the event of roller failure.

**CAR FRAME:**

The car body shall be carried in a structural steel frame having a bolted assembly.

Guide shoes shall be fitted on the car frame. These shoes shall be in accordance with above clauses.

**INSULATION:**

The Contract shall include for all necessary insulating materials, rubber pads, etc. to ensure that each lift runs with the minimum of noise and vibration. Means of preventing or limiting the transfer of noise via the building fabric, particularly from power units, shall be included.

Each lift installation shall be free from vibration and with smooth acceleration and retardation to the reasonable satisfaction of the Engineer.

**GOVERNORS:**

All lifts shall be fitted with speed governors to operate safety gear and where applicable counterweight safety gear in the event of over speed of the lift.

The governor shall be designed in accordance with the requirements of B.S. 5655 and it shall be located with the pulleys.

Governor gears shall have self-lubricating bearing and may have vertical or horizontal governor shafts according to the standard method adopted by the lift manufacturer. Where a governor is located at the top of the lift well, i.e. in the case of hydraulic drive or low-headroom traction below drive, it shall be of the remote or self-resetting arrangement to obviate the need for access through the side walls of the lift well.

**SAFETY GEAR:**

The maximum movement of the governor rope relative to the car or counterweight to operate gradual or progressive type safety gear shall be as set out below. The distance shall be taken as that from the initiation of application of the gear to the position where the safety jaws begin to exert pressure against the guide rails.

**1. For car safeties:**

Car speeds up to 1.0 m/s 1050 mm

Car speeds between 1.0 m/s and 1.8 m/s 900 mm

Car speeds above 1.8 m/s 750 mm

**2. For counterweight safeties :**

All speeds 1050 mm

Drum operated car and counterweight safeties, requiring continual unwinding of the safety drum rope to fully apply the safety gear, shall be so designed that not less than three complete turns of the safety rope shall remain on the drum when the car or counterweight comes to rest after application of the safety gear with contract load in the car. Safety gear shall comply with B.S. 5655 in all respects



#### **GUARDING:**

The Contract shall include the provision of guards to protect accessible moving parts in the machine room and wells. Guards shall as a minimum comply with the Factory Act, Health and Safety at Work etc., Act 1974 and B.S. 5655. In addition to items mentioned or implied in B.S. 5655, guards shall be provided over multiplying pulleys mounted on cards and diverter pulleys and main shelves for 'machine below' installations. Particular attention shall be paid to the proximity of moving parts in compact machine rooms, where hazardous working conditions may be present during maintenance procedures.

These guards shall be of rigid mesh construction to allow visual inspection of the lift equipment without removal and shall be designed for easy and safe removal and replacement during maintenance or repair operations.

#### **LANDING DOOR LOCKS:**

Each set of landing doors shall be fitted with effective electro-mechanical locks in accordance with B.S. 5655 to ensure that it is impossible under normal conditions to open any landing door unless the lift is stationary at that particular landing and that the lift cannot move or be kept in motion unless all the landing doors are properly locked, except when the car is levelling on slow speed within the levelling zone.

Each lock shall be provided with an emergency release device to permit the doors to be opened by an authorised person in an emergency, irrespective of the position of the lift.

This device, if different to the B.S. 5655 standard arrangement, shall not be capable of being operated by the use of wire, screwdrivers, other common tools, etc., particularly in the event of the escutcheon plate being distorted or missing.

When multi-panel doors are specified / used and if they are solely interconnected by a steel cord then a device shall be incorporated to ensure that, in the event of the cord breaking or becoming slack, all panels remain mechanically locked.

#### **FASCIA PANELS AND TOE-GUARDS:**

Each landing entrance shall be fitted with steel fascia panels of minimum thickness 16 swg under the contract. Toe guards will not be accepted.

The panels shall accord with the requirements of B.S. 5655 and shall extend from the landing sill to the entrance header below. Adequate bracing to minimise distortion shall be incorporated.

A steel ramped toe-guard shall be installed below the sill at the lowest terminal floor, whilst a ramped steel section shall be fitted to the header at the top terminal floor.

A ramped toe-guard shall be fitted below the car doorsill to B.S. 5655 requirements.

#### **CONTROLLER:**

The control equipment shall be protected by a sheet steel ventilated enclosure primed and cellulosed in the manufacturer's standard colour.

The cubicle shall be arranged for wall mounting or, if floor mounted, for front access only, with doors fitted. The door(s) shall be secured closed by a mechanical lock opened by a special key for use by authorised persons only.

The functions of all components in the control panel shall be clearly indicated on a diagram together with a key to abbreviations or symbols used which shall be attached to the inside of the control cubicle door.

All terminals used for voltages in excess of 110v a.c. shall be of the shrouded pattern. All terminals shall be located to permit ease of access & rewiring by service engineers, particular attention being given to those for the incoming electrical supply.

The control circuit shall be protected by a single pole circuit breaker of the electro-magnetic type giving instantaneous protection for an overload current of 50% above its full load rating, having a free handle and clear indication of whether the circuit is open or closed.



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The car and landing indicator lamps shall be fed by a supply not exceeding 120V which, if a.c., shall be obtained through the medium of a double-wound, earthed screen protected transformer, the secondary winding of which shall be connected to earth. All transformers shall include adjustable tappings to compensate for normal variations to the input power.

A device providing protection against reverse phase and phase failure shall be incorporated. This shall automatically reset on correct phase restoration.

Overload devices shall be incorporated that will cut-off the control supply if the motor is overloaded for a predetermined time. As an alternative to motor overload protection being provided on the control system, a circuit breaker may be provided. This protection shall be in addition to or in place of any thermal device embedded in the motor windings and omission of this item will not be accepted. The trip time shall be adjustable by authorised service personnel.

The wiring and enclosures from the main isolator in the machine room to the circuit breaker or control panel, and the continuation of the supply, shall form part of the Contract.

A sounder and associates on/off switch shall be incorporated into the front of the control panel to allow audible indication that the car is at floor level during manual operation procedures.

All wiring shall be terminated, any spare cores or cables being terminated into earthed terminals and clearly identified as being spares.

The Contractor shall confirm that equipment, controllers and software offered, particularly where programmable logic controllers are utilised, will :

1. Handle date information before, during and after 1 January 2000, including but not limited to accepting date input, providing date output and performing calculations on dates or portions of dates.
2. function correctly and without interruption before, during and after 1 January 2000 without any changes in operation associated with the advent of the new century;
3. respond to 2-digit input in a way that removes ambiguity as to century in a disclosed, defined and pre-determined manner.
4. Store and provide output of date information in ways that are unambiguous as to century;
5. Recognise that the year 2000 is a leap year, specifically that 29 February 2000 is a valid date.
6. The Contract shall include a suitably sized adaptable box, fitted with suitable terminals and located outside of the control panel, to permit the continuation by others of remote passenger alarm lift fault and loss of electrical power signals, if required. These terminals shall be clearly identified and connected to suitable non-latching relay contacts to give volt free clean contact signals.

**RADIO AND TELEVISION SUPPRESSION ON ELECTRICAL EQUIPMENT:**

All electrical equipment such as motors and all thermostats shall be provided with radio and television suppressors, complying with the requirements of the Post Office Regulations. For the purpose of this clause, limits shall be as set out in B.S. 800.

**CONDUIT, TRUNKING AND CABLES:**

All cables shall be enclosed in screwed and welded galvanised conduit or trunking manufactured in accordance with B.S. 4568 and B.S. 4678 respectively. Manufactured solid or inspection elbows or tee pieces shall not be used.

All trunking or conduits crossing the machine room for equipment cable interconnections shall be run at high level, or around the walls. The Contractor shall ensure that trip hazards are obviated.

All conduit connections to motors or other such items or removable equipment, shall be made with PVC sheathed metallic flexible conduit.



Flexible conduits shall be not less than 300mm nor more than 1.0m in length unless the written permission of the Engineer to exceed these limits is obtained. A separate earth wire shall be run through all flexible conduits. Flexible conduit shall not be used for connections on the lift car. Wiring to the car top shall be contained in steel trunking located to avoid trip hazards, with solid conduit to the item of equipment. Non-metallic conduit and trunking will not be accepted.

Trailing cables between the lift car and the control panel or half-way connection box shall be constructed in accordance with B.S. 6977 and Kahramaa Requirements. Mains, control and telephone circuits shall be separated.

#### **WELL LIGHTING:**

The Contract shall include the provision and installation of lighting to all wells and pits. This shall comprise compact fluorescent or 2 x 13 w linear fluorescent bulkhead fittings with opal polycarbonate diffusers positioned:-

500 mm above the pit slab

500 mm below the top of the well

At intervals not exceeding 6000 mm down the well.

The lights shall be controlled by a pair of 2 way switches, one in the well positioned so as to be accessible from the bottom landing entrances with the other positioned in the lift machine room.

The lights and switches shall be served from a supply provided in the machine room.

Also included shall be the provision and installation of a 13 amp. switched socket outlet within the pit, being located more than 1.0m above pit slab level.

#### **MAINTENANCE CONTROL:**

A maintenance control station shall be provided on the top of the lift car, and this shall include the following controls :-

A switch to remove the lift from automatic control and to allow it to be operated at a slow maintenance speed only.

UP, RUN and DOWN control pushes arranged such that the lift will only move when a direction push is subjected to continuous pressure together with the run push. An emergency stop/run switch.

A door OPEN/CLOSE switch.

The switch shall also include a compact fluorescent light fitting complete with guard. The light fitting may be demountable for use as a wander light. A 13 amp type switched socket outlet (fused 5 amps) and labelled 'TOOLS AND HAND LAMPS TO BE CERTIFIED DOUBLE INSULATED TYPE, MAXIMUM 1000 WATTS' shall also be fitted to the station.

A terminal stop switch shall be incorporated in the control to stop the car, when moving in an upward direction, with its roof not less than 1.80m from the top of the well.

The function of each switch or push shall be identified by a permanent and durable label in the national language of the country of installation. Additional permanent labels (i.e. 'Traffolyte' or similar) for the UP, DOWN and RUN push buttons shall be fitted where the original labels cannot be viewed whilst operating the buttons.

#### **EMERGENCY ALARM AND CONTROLS:**

Each lift car shall be fitted with an alarm push incorporated in the car control station.

The supply for the emergency alarm system shall be obtained from a 12-volt trickle charged battery incorporating automatic voltage regulation and the Contract shall include for the supply and installation of the charger and batteries. The battery and charger used for the Emergency Alarm System shall be separate from



that used for the emergency lighting and shall be located inside the control panel or attached to the side of the panel.

The Contract shall include wiring and enclosure from the supply in the machine room to the respective lift car.

The Contract shall include the wiring from the alarm push in the car to an adaptable box with fixed terminals located in the well at a point above the ground floor landing entrance. The wiring and enclosures shall be continued under the Contract from the adaptable box to a sounder positioned outside the well above the ground floor landing entrance. To avoid confusion, this sounder shall differ from any other sounder in the building (particularly those used in the fire alarm installation) and the Contractor shall include for

liaison with other contractors to ensure that this requirement is met. A second, lower power sounder shall be fitted to the lift car to reassure passengers that the alarm system is operating.

The alarm power pack shall also provide power via a switch to an audible sounder on the control panel to denote that the lift is at floor level during manual operation procedures.

A pair of volt-free contacts shall be included to permit the emergency alarm to be signalled at a remote point. The Contract shall include for the connections to these contacts to be made in a suitable steel enclosure outside of the control panel in the lift motor room. Continuation from this connection point to the remote indication shall be carried out outside of the Contract.

An emergency Run/Stop switch shall be installed in each pit. The switch shall be positioned so that it is accessible from the lowest landing entrance.

Additional Run/Stop switches shall be installed in any secondary room or compartment that is separate from the machine room or lift.

The contract is to include for full interface of lifts specialist works with the project Building Management System (BMS) and the Analogue Addressable Fire Alarm System.

#### **TELEPHONE STATION:**

Flush mounted telephone cabinets shall be provided in all passenger, bed-passenger and goods/passenger lift cars for housing emergency telephone equipment.

The cabinet shall have minimum internal dimensions of 385 mm high x 160 mm wide x 130 mm deep, being suitable for a wall-mounted B.T. Viscount telephone, and shall have an inner compartment at the top of the cabinet. This inner-compartment shall have internal dimensions 85 mm high x 60 mm deep x full width of the cabinet, being for the accommodation of the line socket, and shall have a lid secured by means of a tamper-resistant screw (R.S. system Zero or similar).

The cover-plate of the telephone recess shall match the remainder of the metalwork associated with the car controls. Hinges used under the Lift Contractor's standard arrangement shall not encroach on the dimensions declared above. The outside of the cover shall be inscribed with an emergency telephone symbol. The means of opening the cover shall be designed bearing in mind its possible use by persons with restricted manual dexterity.

The Contract shall include the provision of and installation of an exclusive multi-core, 250-volt travelling flexible cable in accordance with B.S. 6977. The number of cores shall be taken as five but before installation confirmation shall be sought of the number of cores required for the telephone and one spare core shall be allowed in the travelling cable.

The weight of the travelling cable shall be supported at each termination by means of a special insulated device similar to that used for supporting the other travelling cables.

The travelling cable associated with the telephone circuit shall be terminated in a separate terminal block from those used for other travelling cables. An adequate separation of the circuits shall be maintained at the termination.



The Contract shall include the wiring between the telephone terminal block within the telephone cabinet and the lift car end of the travelling cable.

The cables shall enter the terminal block through a hole in the lift car wall above the telephone.

The telephone wiring between the lift well end of the travelling cable and the telephone terminal block which gives access to the telephone network shall form part of the Contract. The terminal block shall be contained within an adaptable box positioned in the lift motor room at a point accessible to the Electrical Contract, the exact termination point being agreed on site between the Electrical Contractor and the Lift Contractor.

The cable used for connection between the ends of the travelling cable and the telephone connection points within the adaptable boxes shall be approved type telephone cable having PVC insulation and sheath and shall be enclosed in steel conduit connected directly to the telephone adaptable box.

#### **HALL DIRECTIONAL ARROWS AND GONGS:**

UP and DOWN illuminated directional arrows of the flush mounted type shall be provided at all intermediate landings with single arrows provided at terminal landings.

The arrows shall be illuminated when a car stops at the landing and shall indicate the direction in which the car is travelling. The arrows shall remain illuminated until the car leaves the landing.

If a free car answers a landing call and no direction of travel has been set then both direction arrows shall be extinguished until a car call is registered. At this stage the appropriate direction arrow shall then become illuminated.

The arrival of a car at a floor shall be announced by a single stroke gong.

The metalwork of the arrows shall be finished as the landing call stations and shall be mounted above or alongside the lift car entrance.

#### **CAR POSITION INDICATOR:**

A flush mounted digital display car position indicator shall be provided inside each lift car and at the ground floor entrance.

The indicator shall be integral with the car control station and integral either with the call station or the direction arrows at the landing.

#### **OUTLINE SCHEDULE OF SYSTEM FUNCTION REQUIREMENT:**

##### **DOOR SAFETY:**

Multi-beam door sensor System consists of a transmitter detector, a receiver detector and a controller. Multi infrared-light beams or a light curtain is achieved by infra-red light beams travelling directly between the transmitter and receiver detectors which cover the full width of the door as it opens or closes to detect Passengers or objects.

The system not only increases passenger safety between the doors but also reduces damage to the lift doors.

##### **HALL INDICATORS:**

Vertical combined unit comprising of digital hall position indicator, directional arrows and micro push call button which self-illuminate on registration of calls at all floors. Face plate finished in hairline stainless steel.

##### **SPECIAL FEATURES:**

###### **Data Network System:**

The controller includes the data network system. The system allows for Microprocessor at each floor to be connected via a serial transmission for faster and efficient data transmission.

**Next Landing Facility:** If the hoistway doors become jammed by a pebble, debris etc., the passengers will not be able to alight from the car. In order that the passengers do not get stranded at the affected floor, the



elevator will proceed to the next floor for which a call has been registered and the doors will open automatically.

**Low Speed Automatic Rescue Operation:**

In the event the elevator should stop between floors, the cause of the malfunction will have to be checked out automatically. When the safety has been confirmed, the elevator will proceed at low speed to the nearest floor, so that the passengers can alight from the car.

**Continuity of service:**

A car experiencing trouble is automatically withdrawn from group operation to protect overall group performance.

**Car call cancelling:**

When a car responds to the final car call in one direction, the system automatically checks and clears the remaining calls in another direction from memory.

**Overload Protective Device:**

This device will make the elevator inoperative with audible indication and signal lighting in the event the elevator car is overloaded beyond the rated capacity.

**Backup operation for group control microprocessor:**

The backup function installed in the system prevents the loss of group control due to failure of a microprocessor or transmission line.

**Automatic Hall Call Registration:**

If all passengers are not able to enter a car when it arrives at a floor because the car is near full-capacity, a hall call is automatically registered for the remaining passengers on that floor.

**Independent Operation:**

The elevator will respond to the car calls, independent of the group control when the key operated switch inside the service cabinet is switched on. The car and hoistway door will remain open when the car is at a landing until another car call is given. If several car calls are given, it will be necessary at each stop to press Door Close button to effect closing of doors.

**Peak Traffic Control:**

To alleviate traffic congestion at the main floor, cars are automatically assigned to the floor where traffic is heaviest.

**Strategic Overall Assignment:**

Combining all of the building traffic conditions, the system forecasts where future service will be needed and assigns an elevator accordingly.

**Door Sensor Self-Diagnosis:**

If a non-contact door sensor fails, the system will automatically determine the timing of door closing to maintain the elevator service.

**Automatic Door Speed Control:**

The system monitors the actual door load conditions at each floor and automatically adjusts the door speed and torque accordingly.

**Automatic Door Open Time Adjustment:**

The system judges the situation whether the car stops responding to a car call or a hall call and controls the time the doors stay open accordingly. The time spent waiting for the elevator is shortened, and operating efficiency is increased.

**Door Nudging Feature – Without Buzzer:**



If the doors remain open longer than the preset period, a temporary override automatically closes the doors.

**Door Load Detector:**

When an object is caught in opening/closing doors, the doors will reverse direction when an excess load is detected. For example, when a pebble becomes lodged in the door track, rather than force itself open/closed, the reverse cycle is repeated until the problem is eliminated.

**Door Open/Close Buttons**

Door Open/Close Buttons on Car Operating Panel.

**Repeated Door-Close:**

Should an obstacle prevent the doors from closing, the doors will repeatedly open and close until the object is removed.

**Hall & call buttons:**

Large square click type hall & call buttons for ease of operation with only 0.2 mm micro-stroke (displacement). Buttons are back lit for easy identification of registered calls.

**Car Arrival Chime:**

An electronic chime (mounted on the car top and bottom) sounds to inform waiting passengers of the car arrival.

**Emergency lighting:**

Emergency lighting in the car with trickle charger unit.

**Inter Phone:**

Two way communication Interphone system.

**Position Indicators:**

Dot matrix display with Alpha numeric indication for near perfect numbers. Orange when illuminated for higher visibility under all light conditions.

**Firemen's Emergency Operation:**

When the Firemen's switch, located at the elevator lobby, is activated during a fire or other emergency, all calls are cancelled and the designated elevator of the group returns immediately to a specified floor. To facilitate firemen's use afterwards, the elevator responds only to car calls.

**Emergency Landing Device:**

This device will bring the elevator to nearest floor by standby batteries allowing passengers to alight from the car in the event of power failure.

**Alarm Bell:**

DC Alarm Bell.

Hand-winding operation for emergency purposes

**QUALITY ASSURANCE**

**INSTALLERS QUALIFICATIONS:**

- Installer experienced to perform work of this section who has specialized in the installation of work similar to that required for this project for at least (5) five years and who is acceptable to product manufacturer.
- Installer shall be authorized by the manufacturer in written and the work shall be supervised by a person having successfully completed a manufacturer training seminar regarding proper installation of the specified product.

**MANUFACTURER'S QUALIFICATIONS:**



- Manufacturer to have minimum (5) five years successful experience in the fabrication of lifts of the type required for this project. Manufacturer capable of providing field service representation during installation, approving acceptable installer and approving application method.

#### **WARRANTIES**

##### **MANUFACTURER'S WARRANTY:**

- Lifts to be warranted against defect in material and workmanship for a period of 1 year from the Date of Substantial Completion. Manufacturer's warranty is in addition to, and not a limitation of, other rights owner may have under Contract Documents.
- Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panel that shows evidence of deterioration of factory-applied finishes within specified warranty period.
- **Finish Warranty Period:** 5 years from the date of final acceptance. Manufacturer agrees to extend the warranty for 5 years if cleaning and maintenance is performed by Kahramaa as per manufacturer recommendation.

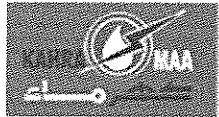
##### **DISTRIBUTOR'S WARRANTY:**

- Two year warranty: Labour and transportation charges for defective parts replacement.

##### **INSTALLER'S WARRANTY:**

Lifts installer warranty, on warranty form at the end of this section, signed by façade panel installer, in which façade panel installer agrees to repair or replace components of custom-fabricated metal wall panel that fail in material and workmanship within specified warranty period. Failures include, but are not limited to, the following:

- Structural failures
- Loose parts
- Wrinkling or buckling
- Deterioration of metal, metal finishes and other material beyond normal weathering, including non-uniformity of colour or finish
- Galvanic action between Aluminium coated panel and dissimilar material.



## APPENDIX 3A – SANITARY SCHEDULES

### SANITARY SCHEDULE

#### A. MALE TOILET

##### 1. WC

- a. Ideal Standard Create Back-to-Wall floor mounted WC – E3013 01
- b. Ideal Standard Create Seat & Cover – E3044 01
- c. Armitage Shanks Conceala 2 Cistern Water Saving Dual Flush – S364367
- d. Ideal Standard Dual Flush Plate Brushed Nickel – S4399AA

##### 2. Toilet Paper Holder

- a. Bradley SS Toilet Roll Holder – 5106

##### 3. Robe Hook

- a. Bradley SS Double Robe Hook – 9124.

##### 4. Shattaf

- a. Grohetec Relexa 27828 – Matt Chrome finish
- b. Accessories: Grohetec Relexa 22940 – Chrome finish

##### 5. Wash Basin

- a. Armitage Shanks Marlow 48cm Counter Basin – S2565
- b. Bottle Trap 1-1/4" CP – S891067
- c. Fixing Clips and Bolts – S911867
- d. Waste 1¼" brass - S8733AA
- e. Trap 1¼" plastic bottle S891067
- f. Fixing clips and bolts - S911867
- g. Armitage Shanks Avon 21 Basin Push Button Self Closing Mixer - B8263AA

##### 6. Soap Dispenser

- a. Bradley SS wall mounted soap dispenser - 6562

##### 7. Paper Towel Dispenser / Waste Receptacle

- a. Bradley SS Recessed Paper Towel Dispenser / Waste Receptacle – 2017

##### 8. Urinal

- a. Armitage Shanks Contour HygenIQ Urinal – S611901
- b. Armitage Shanks Sensorflow 21 Compact Urinal Flushing – A4854AA



**9. Urinal Division**

- a. Ideal Std VC Urinal Division – W3904WHIT

**10. Floor Drain Cover**

- a. Marley SS Floor Drain Cover – 15 x 15cm – SGG4

**11. Shower Tray**

- a. Ideal Std Ideallite Shower Tray 80x80cm – L6633401
- b. Ideal Standard TT Ascari Built-in Shower Pack With Idealrain L3 Shower Kit – A5786AA

**12. Soap Dish**

- a. Ideal Std Concept – N1323AA

**14. Janitor Sink**

- a. Armitage Shank Janitorial Unit – S6509
- b. 1-1/2" Strainer waste CP – S8760AA
- c. Janitorial Sink Mixer – B2809

**B. FEMALE TOILET**

**1. WC**

- a. Ideal Standard Create Back-to-Wall floor mounted WC – E3013 01
- b. Ideal Standard Create Seat & Cover – E3044 01
- c. Armitage Shanks Conceala 2 Cistern Water Saving Dual Flush – S364367
- d. Ideal Standard Dual Flush Plate Brushed Nickel – S4399AA

**2. Toilet Paper Holder**

- a. Bradley SS Toilet Roll Holder – 5106

**3. Robe Hook**

- a. Bradley SS Double Robe Hook – 9124

**4. Shattaf**

- a. Grohetec Relexa 27828 – Matt Chrome finish
- b. Accessories: Grohetec Relexa 22940 – Chrome finish

**5. Wash Basin**

- a. Armitage Shanks Marlow 48cm Counter Basin – S2565
- b. Bottle Trap 1-1/4" CP – S891067
- c. Fixing Clips and Bolts – S911867
- d. Waste 1¼" brass - S8733AA
- e. Trap 1¼" plastic bottle S891067
- f. Fixing clips and bolts - S911867
- g. Armitage Shanks Avon 21 Basin Push Button Self Closing Mixer - B8263AA



**6. Soap Dispenser**

- a. Bradley SS wall mounted soap dispenser – 6562

**7. Paper Towel Dispenser / Waste Receptacle**

- b. Bradley SS Recessed Paper Towel Dispenser / Waste Receptacle – 2017

**8. Floor Drain Cover**

- c. Marley SS Floor Drain Cover – 15 x 15cm – SGG4.

**9. Shower Tray**

- a. Ideal Std Ideallite Shower Tray 80x80cm – L6633401
- b. Ideal Standard TT Ascari Built-in Shower Pack With Idealrain L3 Shower Kit – A5786AA

**10. Soap Dish**

- a. Ideal Std Concept – N1323AA

**11. Janitor Sink**

- a. Armitage Shank Janitorial Unit – S6509
- b. 1-1/2" Strainer waste CP – S8760AA.
- c. Janitorial Sink Mixer – B2809

**C. DISABLED TOILET**

**1. WC**

Ideal Standard San Remo handicapped wall mounted WC – R3402WHIT.

Ideal Std Seat & Cover – R3916WHIT.

Ideal Std Support Brackets – S920067.

Armitage Shanks Conceala 2 Cistern Water Saving Dual Flush – S364367

Ideal Standard Dual Flush Plate Brushed Nickel – S4399AA

**2. Washbasin**

- a. Armitage Shanks Contour 21 37cm Handrinse Washbasin - S212201
- b. Armitage Shanks Contour 21 Thermostatic Sequential Basin Mixer - A4131AA
- c. Hangers concealed, Steel - S911067
- d. Waste 1¼" plastic strainer - S881001
- e. Trap 1¼" metal bottle - S8900AA
- f. LJ Grab Rail – Straight – 60cm – LJ2
- g. LJ Hinged Arm Support Rail – LJ2601+LJ2617

**3. Shattaf**

- a. Grohetec Relexa 27828 – Matt Chrome finish
- b. Accessories: Grohetec Relexa 22940 – Chrome finish



**4. Floor Drain Cover**

- a. Marley SS Floor Drain Cover – 15 x 15cm – SGG4.

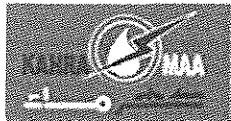
**D. ABLUTION AREA**

**1. Ablution Spray Set**

- a. Model: Grohetec Relexa 27828 – Matt Chrome finish
- b. Accessories: Grohetec Relexa 22940 – Chrome finish
- c. Manufacturer: Grohetec
- d. Supplier: Contractor's proposal and Employer's Representative approval

**2. Ablution Mixer**

- a. Taps: electronic mixer model Hytronic 88 ref# 116.118.2.1,
- b. Manufacturer: Geberit
- c. Supplier: Contractor's proposal and Employer's Representative approval
- d. Sealing: White silicone Mapei Mapesil AC 100



## **4.14 Welding Inspection and Testing of Steel Pipes**

### **4.14.1 General**

Contractor to include the provision of service by a Kahramaa/Engineer approved third party inspection (TPI) subcontractor to cover inspection activities in addition to Contractor's own inspection.

As part of Contractor organisation, the Contractor shall submit to Kahramaa/Engineer his proposed QA/QC/Inspection organisation.

The Contractor shall submit detailed non-destructive examination (NDE) procedures for Kahramaa/Engineer approval. All NDE shall be carried out in accordance with the procedures approved by Kahramaa/Engineer.

The radiographic inspection procedures shall include film-processing procedures to be used for non-destructive examination (NDE).

The Contractor shall demonstrate, to the satisfaction of Kahramaa/Engineer non-destructive testing production technique of exposure, film screen combination, use of lead screens, and film processing and handling are satisfactory and meet this specification. The resultant radiographic procedure shall be considered the Standard Test Radiographic Procedure. The production radiographs shall, as a minimum, be the same quality as the Standard Test Radiograph. The radiographic inspection procedure shall be submitted to Kahramaa/Engineer for approval.

The Standard Test Radiograph shall be repeated at the option of Kahramaa/Engineer vary appreciably in details, contract or density, from the Standard Test Radiograph.

Radiographic inspection shall be conducted by the use X-rays. Gamma ray examination may only be used with the approval of the Kahramaa/Engineer. Radiographic sources and procedures shall be subject to the approval of Kahramaa/Engineer.

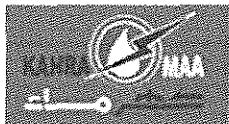
The Contractor shall submit detailed radiation safety procedures which comply with Kahramaa safety regulations.

Radiographic inspection shall comply with the relevant safety codes and radiation control procedures. Special attention is drawn to the necessity for audible and visual warning devices and for regular monitoring of radiation levels.

Radiographic procedures shall be qualified using both source and film side penetrometer.

Each radiographic film shall contain the following identification information:

- Project identification
- Weld number
- Welder number
- Pipe diameter and wall thickness
- Date
- Film location markers related to the area of weld that the radiographic covers



- NDE Contractor's symbol
- Weld thickness
- Image Quality Indicator

The zero datum shall be top dead centre of the pipe. Defect location shall be in metric units system. Each radiograph shall have reference markers at 10 cm intervals.

The letter "R" shall appear on all radiographs of weld repairs in addition to the above information.

The RT films shall be stored and kept by the Contractor until final handing over, and shall be available at any time for Kahramaa/Engineer review.

The Contractor shall provide easy access to the jobs for inspection and NDE and shall provide full co-operation and all assistance that Kahramaa/Engineer may request.

Prior to the commencement of work, the CONTRACTOR shall establish an identification system such that each assembly, each component and each weld can be uniquely and fully identified with welder/welding operator, welding procedure specification (WPS), NDE procedure/technique, extent of NDE and NDE results.

Procedures for radiography, ultrasonic, magnetic particle and dye-penetrant examination shall all be conducted in accordance with ASME Section V.

All personnel performing NDE shall have ASNT Level II or equivalent certification as approved by Kahramaa/Engineer prior to the commencement of work.

The Contractor must submit weld map showing NDE system for Kahramaa/Engineer and written Kahramaa/Engineer approval is required prior to the commencement of fabrication.

### **1. Reduced Percentage Examination**

For any examination frequency shall apply as provided below.

- (a) At least '10' percent of the total number of welds within the specified line class shall be examined for 100% of their length (circumference).
- (b) At least '10' percent of the total number of welds on each isometric shall be examined and shall not be less than one weld per isometric.
- (c) At least '10' percent of the total number of welds made by each welder shall be examined for 100% of their length. At least one complete weld shall be examined for each welder.
- (d) Examinations shall be representative of the entire range of pipe sizes and joints that have been welded.
- (e) Where reduced percentage examination is required and the resulting test shows defects, then additional examinations as required by ASME B 31.3 para 341.3.4 shall apply regardless of the examination process used.
- (f) Defect acceptance criteria for all reduced percentage examinations shall be the same as for 100% examination.



#### **4.14.2 Visual Examination**

Prior to visual examination, welds and the adjoining areas shall be thoroughly cleaned free of all slag, mill scale, dirt, weld spatter, paint, oil, flux, stub ends and other foreign matter.

The Contractor shall provide easy access to the pipework for inspection. This will include the provisions of ladders and scaffolding when required.

The workmanship and weld finish shall be as per this specification.

Weld acceptance criteria for visual examination shall be as per ASME B31.3, Table 341.3.2 except as modified by this specification.

#### **4.14.3 Radiographic Examination**

Radiographic procedures shall be in accordance with the methods described in ASME Section V Article 2 except as modified by this section. Radiographs should be evaluated in accordance with ASME B31.3, Table 341.3.2, except as modified by this specification.

Only fine grain, high contrast film or ultra-fine grain high contrast film shall be used. Type 1 film (AGFA, structurix D4 or equivalent) of ASTM E94 shall be used for gamma ray radiography of pipes with wall thicknesses below 10mm. Gamma radiography shall only be used if it can be proven that the required sensitivity can be achieved.

Wherever possible, DIN penetrameters (wire type Image Quality Indicators) shall be used.

Radiographic sensitivity shall be 1.8% or better.

Where film side IQI's are used, correlation of sensitivity with source side IQI'S shall be established before proceeding with inspection

Only lead intensifying screens shall be used.

The radiographic density in the diagnostic area shall be between 2.0 and 3.5

All burn-through shall not be permitted.

Radiography shall be conducted after any required PWHT for final acceptance.

#### **1. Reporting**

The radiography report shall include the following information:

- Contract number
- Project title
- Name of the component



- Source type (X-ray/Ir-192)
- Source strength (mA/curies)
- Focal spot size
- Technique (SWSI/DWDI/DWSI/PANAROMIC)
- Film type and size
- Penetrometer type and number
- Exposure time
- Developing time and temperature
- Density
- Sensitivity
- Lead screens (front and back)
- Specification (ASME B31.3)
- Weld identifications
- Pipe diameter and wall thickness
- Welder identification
- Interpretation
- Remarks (Accept/Reject)
- Radiographer's name and signature
- Date of exposure

#### **4.14.4 Ultrasonic Examination**

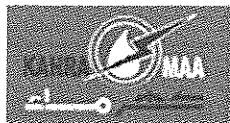
The Contractor shall submit an ultrasonic examination procedure for all full penetration butt and branch welds for Kahramaa/Engineer approval prior to the commencement of examination of production welds.

Ultrasonic examination shall be carried out in accordance with ASME Section V Article 5, except as modified by this section and the results shall be evaluated in accordance with ASME B31.3 Table 341.3.2.

The ultrasonic equipment shall be checked for linearity, db attenuation etc. and a valid calibration certificate shall be submitted for Kahramaa/Engineer review, prior to use.

As a minimum requirement, ultrasonic examination shall be conducted using a minimum of three transducers, one 0° compression and two angle beam transducers with a frequency of 1 to 5 MHZ. Where access permits, ultrasonic examination shall be conducted from both sides of the joint.

Prior to conducting ultrasonic examination, the Contractor shall ensure that the weld and the surrounding area are sufficiently smooth to avoid false or misleading



indications. Transfer correction should be applied to accommodate surface curvature and roughness.

Branch connections that include a reinforcing pad plate shall be examined after welding the branch to the header and again after welding on the reinforcing plate.

The test report should outline the technique employed, type and size and frequency of probes used, and defects discovered and shall contain the following information as a minimum:

- (a) Weld identification and welder number
- (b) Weld procedure used
- (c) Size of reportable defect
- (d) Depth of reportable defect
- (e) Location and orientation of reportable defect (with a sketch)
- (f) Weld acceptable/not acceptable.
- (g) Specification
- (h) Inspector's name and signature
- (i) Date of Examination
- (j) Scanning Diagram.

Ultrasonic examination of welds shall be conducted after PWHT that may be required for final acceptance.

#### **4.14.5 Magnetic Particle**

Magnetic particle examination shall be carried out on magnetic materials.

Weld areas to be examined by magnetic particle examination shall be sufficiently smooth to avoid spurious indications that may result from irregular weld surfaces.

All magnetic particle examination shall be carried out by alternating current yoke method with a white background and black magnetic ink.

Magnetic particle examination shall be carried out in accordance with ASME Section V Article 7. The acceptance criteria shall be as per ASME B31.3 and Table 341.3.2.

Where PWHT is required, magnetic particle examination shall be conducted after PWHT for final acceptance. Examination shall be conducted before PWHT for any repair/rectification that may be required before PWHT.

#### **4.14.6 Ultrasonic Thickness Measurement**

Ultrasonic thickness measurements, where required by the ASME B31.3 code, and/or by Kahramaa/Engineer, it shall be done with Ultrasonic Flaw Detectors. The use of D-Meters is not permitted for thickness measurements.

Where specified by Kahramaa/Engineer, ultrasonic thickness measurements shall be made on both sides of welds at a distance of 25mm from the weld edges.



The thickness readings shall be recorded on NDE spool drawings.

#### **4.14.7 Extent of Non-Destructive Examination**

The minimum requirements of non-destructive examination of welds shall be as per ASME B31.3 code. More stringent NDE may be specified based upon materials of construction, service severity and/or testing limitations.

#### **4.14.8 NDE Personnel Qualifications**

Welding inspectors shall be certified to AWS or equivalent.

All personnel carrying out non-destructive examination (radiography, ultrasonic, magnetic particle and dye-penetrant examination) shall be ASNT Level II certified or equivalent.

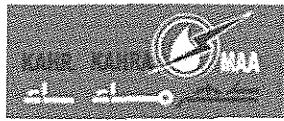
Where the NDE technician is certified by the Contractor himself, the qualification shall be in accordance with Contractor's written procedures which shall use ASNT'S recommended practice No. SNT-TC-1A, as a guide. This written procedure shall be made available to Kahramaa/Engineer whenever required and shall be subject to Kahramaa/Engineer approval.

New qualification tests may be required if a technician's performance indicates deficiencies.

The Contractor shall bear all costs for qualifying technicians and Kahramaa/Engineer Inspector will have the option to witness any qualification tests.

The Contractor shall have records of qualifications and certificates for each technician available for review by Kahramaa/Engineer prior to the commencement of work by the technician.

Any technician may be disqualified by Kahramaa/Engineer upon proof of unethical practices, negligence, non-compliance with procedures or poor performance.



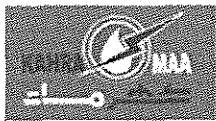
**Qatar General Electricity & Water Corporation**  
Tender NO. GTC 626/2014  
**Construction of Mega Reservoir PRPSs**  
**(Packages A, B, C, D & E)**

## **APPENDIX A SECTION 4**

### **MECHANICAL SPECIFICATION**



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## **4 MECHANICAL WORKS**

### **4.1 GENERAL REQUIREMENT**

Unless otherwise stated in the Project Documentation, the Contractor shall comply with every requirement of the Qatar Construction Specification (QCS) that is relevant to the type of work forming any part of the Contract and shall adopt whichever permissible option or alternative is best suited to the needs of the work being undertaken.

This specification section is for the mechanical installation associated with the main process equipment. Refer to Appendix I7 for the equipment data sheets. Refer to Appendix A7 for mechanical works associated with HVAC, building services, internal building fire fighting and the like.

### **4.2 PUMPS**

#### **4.2.1 General**

##### **4.2.1.1 Scope of Specification**

The Works included in this specification consist of the design, manufacture and witness inspection by the Engineer's representative at the place of the concerned manufacturers works, supply, delivery to site, off-loading, storage, protection, on site storage, site transportation, erection, testing, commissioning of all the equipment detailed in the following clauses for the pumps, motors and starters, all in accordance with the Specification.

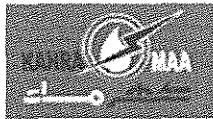
The works shall include all mechanical and electrical works, ancillaries and accessories necessary for the performance and operational requirements herein specified. There shall be included all items, components, connections and services to make the whole installation complete and perfect in every part and detail and operational as a complete integrated station. The Contractor shall include all equipment and services required to provide a fully complete and functional installation.

This specification document comprises the minimum technical requirements for the Works and Compliance with this specification shall not relieve the Contractor from any of his contractual obligations and responsibilities.

The Contractor shall notify the Engineer of any conflict between this specification, the codes and standards and any other specification included as part of the contract documents applicable.

Deviations and conflicts from this specification shall be listed in details and submitted for review and approval. Any conflicts shall be raised by the Contractor in tender stage and be resolved in writing by Kahramaa /the Engineer.

Any exception of this specification and referenced documentation shall be raised by the Contractor and approved by the Kahramaa/ Engineer in writing.



#### **4.2.1.2 Abbreviations**

API	American Petroleum Institute
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BEP	Best Efficiency Point
BS	British Standard
CPS	Corridor Pumping Station
dB	Decibel
DI	Ductile Iron
DIN	Deutsches Institut für Normung e.V. (German Institute for Standardisation)
EN	European Norm
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
IP	Internal Protection
KM	Qatar General Electricity & Water Corporation (KAHRAMAA)
NPSH <sub>A</sub>	Net Positive Suction Head Available
NPSH <sub>R</sub>	Net Positive Suction Head Required
PN	Nominal pressure
QCS	Qatar Construction Specification
RPM	Revolutions per Minute
V	Volts

#### **4.2.1.3 Operating Conditions**

##### **A. Medium Characteristics**

The pumps shall be suitable for handling desalinated potable water with chlorine/chlorine dioxide content within the parameters of the Kahramaa water quality standards.

##### **B. Environmental Conditions**

The pumps and associated equipment shall be designed and be suitable for operation in the climatic conditions of state of Qatar (tropical weather, with excess heat dust and humidity at time). Refer to Appendix A1 section 1.9.

The pumps will be installed indoors, in a closed and ventilated pump house which will be erected within the boundaries of the PRPS site.



#### **4.2.1.4 Standards and Codes**

The works, equipment and materials shall be designed, manufactured and erected according to the following applicable codes, standards (in their latest edition where not otherwise specified)

- Qatar Construction Specification (QCS 2010)
- Qatar General Electricity & Water Corporation: Standards, Specifications and Regulations
- API Standard 610: Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
- EN 10204: Metallic Products – Types of Inspection Documents
- ISO 1940: Mechanical Vibration – Balance Quality Requirements of Rigid Rotors
- ISO 9906: Rotodynamic Pumps – Hydraulic Performance Acceptance Tests Grades 1 and 2
- EN 1561 Founding, Gray Cast Iron
- EN 1092 Circular flanges for pipes, valves and fitting
- BS 970, (ISO 683) Wrought steels for mechanical and allied engineering purposes
- BS 1400, Copper alloy ingots and copper alloy and high conductivity copper coatings
- BS 1452, (ISO 185) Flake graphite cast iron
- BS 3468, (ISO 2892) Austenitic cast iron
- BS 4675 Part 1, Mechanical vibration in rotating and reciprocating machinery
- BS EN ISO 9906, (ISO 2548) Rotodynamic pumps. Hydraulic performance acceptance tests. Grades 1 and 2
- BS 5512, (ISO 281) Methods of calculating dynamic load ratings and rating life of rolling bearings
- BS 6105, (ISO 3506) Corrosion-resistant stainless steel fasteners
- BS 6861 Balance quality of requirements of rigid rotors
- BS EN 10088 (all parts) stainless steels
- BS 6920-2 Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Methods of test. Odour and flavour of water. General method of test
- Other internationally accepted standards, which ensure a quality equal to or higher than the standards mentioned above, if an edition in the English language is available. Then Contractor shall provide a copy thereof and provide evidence that the proposed standard will ensure a quality equivalent or higher than the standards referred in this document.

#### **4.2.1.5 Associated Documents**

This Specification shall be read in conjunction with the following documents which, together and in combination, define a complete tender document:

- General Electrical Specification



- General Instrumentation Specification
- General Civil Specification
- Schedule of Technical Particulars
- Schedule of Prices
- Schedule of Drawings.

#### **4.2.2 Main Pumps**

##### **4.2.2.1 Design and Construction Requirements**

The pump covered by this specification shall be suitable for the specified operation conditions and shall be designed and manufactured for a minimum service of 20 years plus minimum of three years of uninterrupted continuous operation or 25,000 hours operation, whichever is later.

Low maintenance cost, reliability and trouble free operation shall be a prime consideration when selecting the bid pumps.

Pumps shall be single stage, double suction, horizontal shaft, centrifugal split case driven by directly coupled electric motor in the horizontal orientation.

The pumps, all accessories and materials, which are in contact with transported medium, shall be suitable for handling desalinated and treated water with chemical properties as described in the general specifications and shall be resistant to erosion and corrosion.

Each pump and its associated equipment have been arranged in such a manner as to permit easy access for operation, maintenance and pump removal without interrupting pumping operation. The Contractor shall confirm the proposed pump arrangement when submitting the construction drawings.

Water velocity in pump suction and discharge nozzles shall not exceed 4 and 5 m/s respectively at maximum operating condition within pump operation specified range.

The pump manufacturer shall coordinate the construction of pump with variable speed drive manufacturer

##### **4.2.2.2 Hydraulic Design Performance**

###### **A. System Curve**

The system curve calculations have been prepared to match pumps duty points and their best efficiency point (BEP) range with different system operating scenarios, based on most severe conditions.

Copies of the anticipated system hydraulics are included, it is the responsibility of the Contractor to verify this information and to provide with his bid the proposed pump hydraulic performance details and system curves based on most severe conditions.

The Contractor shall comply with the surge requirements covered under Clause 4.7.



**B. Working Range**

Generally, pumps shall be selected to have a stable head-capacity curve at all flow rates, i.e. continuous rising type head with decreasing flow. Pump duty points shall be selected to operate at their BEP within the system operating range in different operating scenarios based on most severe conditions.

The pumps shall operate between minimum allowable flow specified by manufacturer/ supplier and 110% of the BEP point at all pumps operating speeds.

**C. Net Positive Suction Head**

The required net positive suction head NPSHR of the pumps, when operating in single duty or as in most cases when operated in parallel, shall be at least 1.5 metres less than the available net positive suction head NPSHA.

The Contractor shall verify the NPSHA value prior to ordering of pumps and submit relevant NPSH calculations confirming the pump satisfactory performance in all operating conditions.

NPSH calculations shall be based on the least favourable operating conditions (lowest atmospheric pressure, lowest level of water on the suction side of the pumps and highest temperature of the fluid). Any deviation in the NPSHR of the pumps shall be corrected at the Contractor's expense.

**D. Pump Efficiency**

Pump efficiency values shall be higher than 85% at rated duty conditions. The minimum efficiency shall not be less than 70% at any other operating point located within specified pump operation range.

**4.2.2.3 Construction**

**A. Casing**

The pump casing shall be made of high grade cast iron as per EN BS 1561 or BS 1452 as a minimum and be free of any blow holes and sand pockets resulting from imperfect and defective castings. Inner surfaces of casing which are in contact with the fluid shall be ideally shaped to match the streamlines and be finished so that minimum head loss and favourable efficiency could be attained.

Pump casing shall withstand at least 1.5 times the shut off pressure of the pump.

All pump casings shall have a minimum corrosion allowance of 3 mm unless otherwise specified in the data sheets.

The casing shall be equipped with vent and drain connections with sufficient clearance as required without dismantling the pump, screwed type, and fitted with removable cocks. The material of construction for the removable cocks shall be stainless steel 1.4401.

All screw or bolt and nut seating in the casing should be machined and the joint face of the pump casing should be sealed by means of flat gasket and bolted together.

All auxiliary piping connected to the casing shall be made of stainless steel 1.4404.

Required allowable nozzle forces and moments shall be carefully determined by the Contractor and Pump set manufacturers, by static pipe-stress analysis software, taking into account the connected pipes and equipment.



The Contractor shall ensure that the installation is carried out properly at site to limit the actual forces and moments on the pump nozzles within the acceptable levels as stipulated by the manufacturer.

**B. Impeller**

The impeller of pumps shall be double suction enclosed manufactured from duplex stainless steel 1.4517 or equivalent and should exhibit excellent corrosion resistance, abrasive-wear resistance, cavitation resistance, weld ability and casting and machining properties.

The impeller vanes design shall be based on manufacture experience to ensure hydraulic balance during all operating conditions.

The proposed Impeller diameter shall not exceed 95% of the maximum impeller diameter. Pumps impeller shall be one machined piece, where practicable, and made as smooth as possible.

The impeller shall be fixed to the shaft using positive one piece key such as it will not loosen or become detached when the pump is rotating in the wrong direction. The impellers together with shaft shall be statically and dynamically balanced.

**C. Shaft**

The pump shaft shall exhibit high tensile strength, endurance limit and corrosion resistance. Pump shaft shall be made of high tensile steel to BS 970, forged stainless steel or other approved material.

All pumps shall have suitable renewable shaft sleeves made from stainless steel 1.4571 or other proper equivalent material. Shaft shall not be in contact with water.

**D. Bearings**

Radial and thrust bearings shall be self-alignment antifriction maintenance free type.

Bearings shall be sized to offer a minimum L10 life of 100,000 hours when operating at any flow rate.

Bearings shall be grease lubricated and completely protected from water ingress by appropriate means.

Bearing supports shall not be bolted type and shall be part of pump casing lower half only.

**E. Wear Rings**

The impeller and casing shall both be provided with appropriate wearing rings. Wearing rings shall be of renewable type and should be easily replaceable. The surface hardness difference between opposed wearing rings shall not be less than 50 BHN, unless otherwise approved by KAHRAMAA/ENGINEER in writing. Impeller wear rings shall be the softer material of the two.

**F. Coupling**

The couplings between motor and pump shall be of the flexible type. Each coupling shall be provided with a removable coupling guard made of durable material with a minimum wall thickness of 1.5 mm.

The coupling hubs on the shafts shall be designed for the easy maintenance. A coupling design with high pressure removal and shrink fit hubs is not permitted.



**G. Base Plate**

Pump motor complete arrangement shall be mounted on one corrosion-resistant fabricated steel base plate to be secured to the foundation with foundation bolts, or other equivalent, and should withstand the weight and vibrations of the pump.

The design of base plate shall be confirmed by the Manufacturer of the pumps and motors.

**H. Seals**

The shaft seals shall be of the mechanical type by an approved specialist manufacturer.

The seals shall be designed and suited for both intermittent and continuous running under all operating conditions. Lubricating and cooling water for the seals shall be drawn from connections on the pump casings.

The sealing construction and design should enable the inspection and removal of the seals without disturbing the pumps.

The seal chamber size should be proper for all the well-known mechanical seals. An inline filter must be used in the flush line to prevent any foreign material from entering the seal chamber.

**I. Gauges and Fittings**

Each pump shall be fitted with liquid filled type pressure gauges on the suction and delivery sides complete with isolating corks and two way manifold.

Pressure gauges shall be 6 inch (150mm) nominal diameter "Industrial" bourdon type in accordance with BS 1780 or equivalent. The suction gauges shall be of compound type with vacuum figures calibrated in red.

The gauges shall be of robust construction, tropicalized with dust and damp proof sealed brass cases or other approved non-corroding solid (not plated) materials. The movements shall be of robust design, capable of withstanding the degree of vibration shocks and pressure fluctuations normally encountered with pump operation when protected by snubbers & 2 way manifold.

Where pressurised oil lubricated sleeve bearing are proposed, a dial type temperature gauge shall be provided on shaft bearing. This shall be waterproof and provided with two adjustable contacts for two stage alarm and shut down.

All gauges on a pump shall be visible from one position and shall be mounted separately as a single panel with 1.4404 impulse line, fixed close to both suction and discharge sides of the pump.

**J. Vents and Drains**

An air-release priming cock shall be fitted at the top of the casing volute on each pump and the discharge piped to one of the shaft gland bowls.

The gland and body drains shall be collected in a drip-tray and the final discharge shall be piped individually from each pump to the drainage channel in the pump house. The drain pipes shall be in 25 mm nominal size heavy wall copper or stainless steel tube fitted with couplings so as to facilitate removal of any possible blockages.

**K. Moving Parts Guard**



Moving parts of pump including all shafts, couplings, and collars, projecting key heads, gear wheels, chain drives and all other moving machinery shall be guarded where necessary to give complete protection to operating personnel.

All set screws on revolving shafts shall be countersunk or suitably protected.

The guards shall be of an approved design and shall be fitted where necessary with inspection doors.

All guards shall be arranged so that they can be removed without disturbing the parts of the gears and equipment they protect.

Guards for shaft couplings shall comply with requirements not less than BS 1649.

**L. End Connections**

Pumps suction and discharge end connections shall be flanged pipe joints located on opposite sides of the lower casing, allowing removal of the rotating assembly without disturbing the system piping connections.

Flanges shall be raised face in accordance with EN 1092 (PN 16/ 25). The pressure rating of the suction nozzle shall be same as the discharge nozzle rating.

Necessary tappings shall be provided on the suction & delivery flanges to allow for installation of the pressure gauges.

**M. Speed of Rotation**

Pumps rated RPM shall be not higher than 1500 RPM; lower speed of rotation is preferred. Speed reduction through variable speed drives shall be limited by 50% of the maximum rated speed.

**N. Vibration**

Vibration limit shall be in accordance with BS ISO 10816. The Contractor shall specify allowable and preferred operating region.

Vibrations shall be measured during the performance tests and during the test run phase of the transmission system.

All the rotating parts should be statically and dynamically balanced as per ISO 1940 and other relevant standards.

The Contractor is responsible to take necessary steps to remedy any vibrations or noise which in the opinion of the Engineer is excessive.

**4.2.2.4 Noise**

Generally noise criteria shall be as per IEC EN 60034-9, EN ISO 20361 and other relevant applicable standards.

The maximum permissible noise level at 1.0 m distance from the pump shall be 85 dB (A). The Contractor shall take the necessary measures to fulfil the environmental requirements outside the pump building.

**4.2.2.5 Coating**

All pumps shall be coated and painted on both outer and inner surfaces. All surfaces shall be thoroughly cleaned free of rust, scale, grease, dirt and moisture before being painted. Grease and oily matter shall be removed by means of a suitable solvent.



Coating of the pumps shall be plastic enamel paint (epoxy resin) inside and outside applied by electrostatic spray process.

The finish coat(s) shall be applied over the dry intermediate or first coat as recommended by the manufacturer.

The internal coating shall consist of primer, intermediate and final coat(s). If more than one coat shall be applied, the second coat shall be applied within time limits recommended by the manufacturer to prevent delamination between coats. A total dry film thickness of not less than 300 microns shall be applied.

The external coating of the pump shall comprise 2 pack epoxy resin to a minimum dry film thickness of 300 microns. The colour of the coating shall be blue.

The coating shall exhibit excellent protection for surfaces of pump and should be resistant against impact and sag. The adhesion or bond of the primer to the metal and the inter coat adhesion of the finish coats and primer shall be perfect.

The coating shall be suitable for drinking water and shall fully comply with BS 6920 standard requirements or approved equivalent.

Proposed coating material must have been applied successfully on at least three similar installations and Contractor shall provide adequate references.

The internal coating system shall be tested in accordance with ISO 2178; it should have a guarantee of at least 7 years under all operating conditions.

#### **4.2.2.6 Nameplate**

Each pump shall be identified by marking and labelling stainless steel nameplate; plate dimensions shall be according to DIN 825 standard. The nameplate shall be securely riveted in a readily accessible position on the pump.

The manufacturer's nameplate shall contain at least the following information:

- a) Manufacturer
- b) Pump Serial No.
- c) Rated Head
- d) Rated Flow
- e) Pump Absorbed Power at Duty Point
- f) Pump Running Speed
- g) Pump Casing Design Pressure
- h) Weights of pump & motor & base plate, in kilograms

#### **4.2.2.7 Motor**

Pump motor shall be in accordance with Section 5.2.

#### **4.2.2.8 Instrumentation**

The pumps and their auxiliaries shall be equipped with all instruments required for safe and correct operation.

As a minimum the following shall be provided per pump:



- a) Bearing temperature (Local thermometers for all bearings)
- b) Local pressure gauges at suction and discharge
- c) Vibration monitoring system, in all axes

A central terminal box for the connection of all supervisory and auxiliary equipment of the pump unit and the lubrication system (if any) shall be foreseen

Refer to other relevant sections of the technical specifications for all other requirements for instruments.

#### **4.2.2.9     Inspection and Testing**

##### **4.2.2.9.1   General**

Before beginning of any fabrication the Contractor shall submit a detailed quality control and inspection and test plan to the Engineer for approval not less than 10 weeks in advance.

The Contractor shall give proper in-advance notice, not less than 4 weeks to the Engineer when fabrication will start and when tests will be made. All quality control operations carried out by the Manufacturers during fabrication shall form the subject of constantly updated reports.

Kahramaa/Engineer reserves the right for shop inspection/stage inspection by their authorised representatives. If witnessing of any tests is not satisfactory and a retest is required, the cost of the witnessed retests shall then be borne by the Contractor.

For each test data, curves, etc. for witnessed test conditions shall be corrected for actual site conditions and submitted for approval by Kahramaa/ Engineer.

The Contractor shall furnish the Engineer with 5 certified copies of the results of all tests prior to shipment of the equipment.

All instruments used during shop tests at manufacturer's premises shall be duly calibrated by recognised laboratories and the calibration certificates shall be inspected and certified by inspectors. The calibration certificates shall not be more than six month old.

##### **4.2.2.9.2   Shop/Factory Tests**

###### **A.   Material Tests**

The Contractor/Manufacturer shall submit material test certificates for all pump components in accordance with ISO 10474 3.1B certificate, for Kahramaa/ Engineer approval prior to manufacturing processes.

The inspection requirements related to the material of construction of the pumps shall include following as a minimum:

- a) Material checks (chemical composition and physical properties);
- b) Casting defects and their classification;
- c) Non-destructive testing (NDT);
- d) Repairs procedures of castings and welding;



#### B. Hydrostatic Test

All pressure containing parts shall be hydrostatically tested at a minimum of 1.5 times the maximum allowable working pressure corresponds to the casing design pressure.

The test will be considered acceptable when neither leaks nor seepage through the casing or casing joints are observed for at least 30 minutes.

The casing shall not show undue deflection at any time during test.

The hydrostatic test shall be certified to EN 10204, certificate 3.1.

#### C. Performance Test

For each pump coupled to its own motor performance tests in accordance with ISO 9906 Grade 1 shall be conducted.

The test curves shall be plotted at minimum of seven heads/flow rates , between zero flow and maximum continuous capacity, together with efficiencies, NPSH, power etc.

Measured values tolerance shall be within acceptable tolerance EN ISO 9906-Grade 1 tolerance grade. However for efficiency, no negative tolerance is acceptable.

Variable speed pumps flow/capacity curve shall be taken also at a reduced speed to be agreed with the Engineer; in addition to, performance tests carried out at nominal pump speed.

#### D. Factory Tests

For each pump coupled to its own motor (if required), following tests shall be conducted as minimum:

- a) Noise and vibration test
- b) Internal/ external coating tests and control
- c) Bearings temperature measurement;
- d) Static and dynamic balancing of rotors and impellers of each motor/ pump set;
- e) Visual inspection including detection of defects, appearance, dimensions etc. Works tests not specifically mentioned above may be required by the Engineer.

#### 4.2.2.9.3 Site Acceptance Test

After complete installation and before commissioning, the Contractor shall carry out site pump set tests in accordance with BS EN ISO 9906 Grade 1, to be witnessed by Kahramaa/Engineer personnel, as well as pump and motor, manufacturer's representatives.



The site tests for individual and parallel pump operation shall include but not be limited to the following measured over the entire specified range:

- Rated flow
- Rated differential head
- Shut-off head
- Rated horsepower
- Vibration of the units
- Noise level
- Water leakage measurements
- Bearing temperature measurements

The measured values shall be as indicated in the Guaranteed Design Tables and in the pump set data sheets submitted by the Manufacturers/Contractor.

Tolerance factors shall be in compliance with BS EN ISO 9906 Grade 1

In case of non-compliance to this required performance or any problems/defects detected during these tests shall be promptly rectified by The Contractor/Manufacturer at no additional cost to Kahramaa/the Engineer.

#### **4.2.2.10 Deliverables**

The Contractor shall submit the following technical deliverables, for the Engineer approval, comprising but not limited to a minimum of the following:

- Pump Technical Datasheet and for auxiliary equipment and instrumentation.
- Pump and Motor Characteristic Performance curves head, efficiency and shaft power and NPSHR values versus flow capacity.
- Parallel pumps operation curves shall be submitted with recorded minimum & maximum flows for all pumps running (variable speed pumps, curves must be submitted showing the performance at minimum of four different speeds)
- Speed-torque curve, Speed – power factor curve, motor thermal capacity...etc
- Detail general arrangement of the complete pump unit (pump and motor) drawings showing dimensions, outlines, sectionals & 3D exploded views, mechanical seals details, allowable forces and moments, instruments P&ID etc.
- Motor water cooling system requirements, calculations and drawings (if needed)
- Complete list of all necessary equipment.
- Complete catalogues of all equipment.
- List of recommended spare parts.
- Details of any special tools required.
- Compliance statement to pump specifications



- Installation instructions including alignment, grouting, connecting of piping, etc. in English and Arabic (if available) in three copies.
- Operating instructions and maintenance manual, illustrated spare parts list, list of recommended spares for five years operation, instructions for daily checking and Maintenance, troubleshooting guide, lubrication and bearing schedule, one month before practical completion (in English and Arabic)
- As-built drawings hard and soft copies in AutoCAD platform.
- Quality control, inspection and test plan
- Method statement for outer and inner surfaces coating as recommended by the manufacturer

#### **4.2.2.11 Spare Parts and Special Tools**

The Contractor shall include in his bid, as a minimum, consumables and spare parts for commissioning, and spare parts for guarantee period operation. The Contractor/Manufacturer shall guarantee the availability of spare parts for a minimum duration of 10 years.

For pumps, motors and relevant ancillaries, the Contractor shall provide a spare parts schedule that the equipment manufacturers considers should be kept in stock to cover replacements over a period of 2 years.

The spares shall be packed and sealed in individual boxes to preserve the parts against damage and corrosion over long storage periods. Each package shall be clearly identified as to its contents in English.

The Contractor shall provide a schedule of special tools needed for repair and maintenance of the equipment included in his bid.

Minimum spare parts required shall be agreed with Client.

#### **4.2.2.12 Guarantee and Warranty**

The warranty period for all of the pump sets shall be two years as defined in General Conditions of Contract. The Contractor shall be responsible for the correction of any defects to the pump sets during the Warranty Period and shall make all necessary repairs and replacements free of charge including labour charges.

#### **4.2.2.13 Retention of pump efficiency for sustainable performance:**

Pumps shall offer sustainable performance over a longer period. Manufacturer shall specify efficiency after defect liability period (2 years), with tolerance limit at the time of the bidding & give warranty for the retention of efficiency after defect liability period (2 years). After completion of defect liability period but before issuing final taking over certificate, Site tests shall be performed as explained above, to ascertain the performance with agreed tolerance. In case of non-compliance to this required performance, the manufacturer/contractor shall take corrective actions as necessary to improve the performance of pumps at his cost. Otherwise Kahramaa may carry out such rectifications from other contractor.



#### **4.2.3 Auxiliary Pumps**

##### **4.2.3.1 Design and Construction Requirements**

This specification covers the minimum requirements for design, manufacture, testing at manufacturer's works, supply, site testing and commissioning of the drain down return, scour and recirculation pumps. The pumps shall be submersible pumps designed for dry well installation and suitable for the specified operation conditions.

The pumps shall be designed and manufactured for a minimum service of 100,000 hours with service intervals at 20,000 hours.

Low maintenance cost, reliability and trouble free operation shall be a prime consideration when selecting the bid pumps.

Castings, fabrications, machined parts and drives shall conform to the industry standards for strength and durability and shall be rated for continuous duty over the entire operating range.

The pumps, all accessories and materials, which are in contact with transported medium, shall be suitable for handling potable water with chemical properties as described in the general specifications and shall be resistant to erosion and corrosion.

Each pump and its associated equipment have been arranged in such a manner as to permit easy access for operation, maintenance and pump removal without interrupting pumping operation. The Contractor shall confirm the proposed pump arrangement when submitting the construction drawings.

Water velocity in pump suction and discharge nozzles shall not exceed 4 and 5 m/s respectively at maximum operating condition within pump operation specified range.

The pump, motor and associated electrical equipment shall be rated for a minimum 10 starts per hour, unless otherwise designated.

##### **4.2.3.2 Hydraulic Design/Performance**

###### **A. System Curve**

The system curve calculations to be prepared, to match pumps duty points and their best efficiency point (BEP) range with different system operating scenarios, based on most severe conditions.

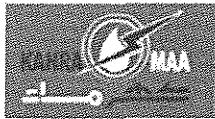
Copies of the anticipated system hydraulics are included with the data sheets, it is the responsibility of the Contractor to verify this information and to provide with his bid the proposed pump hydraulic performance details and system curves based on most severe conditions.

###### **B. Working Range**

Generally, pumps shall be selected to have a stable head-capacity curve at all flow rates, i.e. continuous rising type head with decreasing flow. Pump duty points shall be selected to operate at their BEP within the system operating range in different operating scenarios based on most severe conditions.

The pumps shall operate between minimum allowable flow specified by manufacturer/ supplier and 125% of the BEP point unless the curve does not have an operational limit.

###### **C. Net Positive Suction Head**



The required net positive suction head NPSHR of the pumps, when operating in single duty or as in cases when operated in parallel, shall be at least 1.5 meters less than the available net positive suction head NPSHA.

The Contractor shall verify the NPSHA value prior to ordering of pumps and submit relevant NPSH calculations confirming the pump satisfactory performance in all operating conditions.

NPSH calculations shall be based on the least favourable operating conditions (lowest atmospheric pressure, lowest level of water on the suction side of the pumps and highest temperature of the fluid). Any deviation in the NPSHR of the pumps shall be corrected at the Suppliers expense.

**D. Pump Efficiency**

Pump efficiency values shall be higher than 70% at rated duty conditions. The minimum efficiency shall not be less than 60% at any other operating point located within specified pump operation range.

**4.2.3.3 Construction**

**A. Casing**

Volute casings shall be cast iron, BS 1452 Grade 220 or 250 and be free of any blow holes and sand pockets resulting from imperfect and defective castings. Inner surfaces of casing which are in contact with the fluid shall be ideally shaped to match the streamlines and be finished so that minimum head loss and favourable efficiency could be attained.

All screw or bolt and nut seating in the casing should be machined and the joint face of the pump casing should be sealed by means of flat gasket and bolted together.

Pumps suction and discharge end connections shall be flanged pipe, allowing removal of the rotating assembly without disturbing the system piping connections.

Flanges shall be raised face in accordance with EN 1092 (PN 16/ 10). The pressure rating of the suction nozzle shall be same as the discharge nozzle rating.

Necessary tappings shall be provided on the suction & delivery flanges to allow for installation of the pressure gauges.

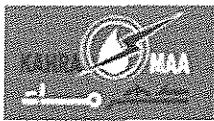
Required allowable nozzle forces and moments shall be carefully determined by the Contractor and Pump set manufacturers, by static pipe-stress analysis software, taking into account the connected pipes and equipment.

The Contractor shall ensure that the installation is carried out properly at site to limit the actual forces and moments on the pump nozzles within the acceptable levels as stipulated by the manufacturer.

**B. Impeller**

Impellers shall be Ni-resist cast iron, BS EN 13835, duplex stainless steel or approved equivalent. Impellers shall exhibit excellent corrosion resistance, abrasive-wear resistance, cavitation resistance, weld ability and casting and machining properties.

The impeller vanes design shall be based on manufacture experience to ensure hydraulic balance during all operating conditions.



The proposed Impeller diameter shall not exceed 95% of the maximum impeller diameter. Pumps impeller shall be one machined piece, where practicable, and made as smooth as possible.

The impeller shall be keyed to the shaft such as it will not loosen or become detached when the pump is rotating in the wrong direction. The impellers together with shaft shall be statically and dynamically balanced. Impellers shall not be trimmed unless approved by the Engineer.

**C. Shaft**

The pump shaft shall exhibit high tensile strength, endurance limit and corrosion resistance. Pump shaft shall be made of high tensile steel to BS 970 or other approved material.

Pump shafts shall be of such diameter that they will not deflect more than 0.05 mm measured at the mechanical seal, whilst operating at full driver output

The shaft shall be turned, round and polished and shall be key-seated for securing the impeller.

**D. Bearings**

The shaft shall rotate on grease lubricated bearings. The support bearing, provided for radial forces, shall be a rolling bearing. The main bearings shall consist of at least one roller bearing for radial forces and one angular contact ball bearing for axial thrust. Bearings shall be sized to offer a minimum L10 life of 100,000 hours with service intervals at 20,000 hours when operating at any flow rate as per BS ISO 281 standard requirements.

Bearings shall be capable of taking the static weight of the rotating parts and any thrust generated by the operation of the pump.

The upper bearing(s) shall be of the grease lubricated sealed for life type, the lower bearing(s) shall be lubricated by the internal oil supply.

The bottom bearing(s) shall be of the angular contact ball bearing type in combinations with roller bearing(s)

The lower bearing housing shall include an independent thermal sensor to monitor the bearing temperature. If a high temperature occurs, the sensor shall activate an alarm and shut the pump down.

**E. Mechanical Seals:**

Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seals, each having an independent spring system. The seal material shall consist of wolfram carbide WCCR (Corrosion resistant tungsten carbide) or approved equivalent. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal function. Should both seals fail and allow fluid to enter the stator housing, an alarm shall stop the pump before the fluid come into contact with the lower bearings, or the stator. The outer primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide ring or approved equivalent. The inner secondary seal, located between the seal chamber and the seal inspection chamber shall be an active seal. The inner seal shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. The rotating inner seal ring shall have small back-swept



grooves laser inscribed upon its face to act as a micro pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

In the case of a seal cavity, the area about the exterior of the lower mechanical seal in the housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to affect sealing shall be used.

#### F. Wear Rings

Material of the renewable rings (where fitted) for casing shall be brass BS 1400. Material of the renewable wear rings for impeller shall be stainless steel EN 1.4031 or the approved manufacturers standard. Wear rings shall be easily replaceable. Clearance within the rings shall be acceptable and according to manufacturer standard or other approved standards. Casing ring hardness shall exceed impeller ring hardness at least for 50 points of the Brinell scale.

#### G. Speed of Rotation

Pumps rated RPM shall be not higher than 1500 RPM; lower speed of rotation is preferred. Speed reduction through variable speed drives shall be limited by 50% of the maximum rated speed.

#### 4.2.3.4 Vibration

Vibration limit shall be in accordance with BS ISO 10816. The Contractor shall specify allowable and preferred operating region.

Vibrations shall be measured during the performance tests and during the test run phase of the transmission system.

All the rotating parts should be statically and dynamically balanced as per ISO 1940 and other relevant standards.

The Contractor is responsible to take necessary steps to remedy any vibrations or noise which in the opinion of the Engineer is excessive.



#### **4.2.3.5 Noise**

Generally noise criteria shall be as per IEC EN 60034-9, EN ISO 20361 and other relevant applicable standards.

The maximum permissible noise level at 1.0 m distance from the pump shall be 85 dB (A). The Contractor shall take the necessary measures to fulfil the environmental requirements outside the pump building.

#### **4.2.3.6 Motor**

All pumps shall be equipped with motor water (cooling) jacket. The motor water jacket shall encircle the stator housing and shall be made from stainless steel or approved equivalent.

Refer to other relevant sections of the technical specifications for all other requirements for motors.

#### **4.2.3.7 Instrumentation**

The pumps shall be equipped with all instruments required for safe and correct operation.

As a minimum the following shall be provided per pump:

- Bearing temperature
- Local pressure gauges at suction and discharge
- Vibration monitoring system
- Moisture monitoring system

A central terminal box for the connection of all supervisory and auxiliary equipment of the pump unit and the lubrication system shall be foreseen.

Refer to other relevant sections of the technical specifications for all other requirements for instruments.

#### **4.2.3.8 Speed of Rotation**

Pumps rated RPM shall be not higher than 1500 RPM; lower speed of rotation is preferred. Speed reduction through variable speed drives shall be limited by 50% of the maximum rated speed.

#### **4.2.3.9 Coating**

All pumps shall be coated and painted on both outer and inner surfaces. All surfaces shall be thoroughly cleaned free of rust, scale, grease, dirt and moisture before being painted. Grease and oily matter shall be removed by means of a suitable solvent.

Coating of the pumps shall be plastic enamel paint (epoxy resin) inside and outside applied by electrostatic spray process.

The finish coat(s) shall be applied over the dry intermediate or first coat as recommended by the manufacturer.



The internal coating shall consist of primer, intermediate and final coat(s). If more than one coat shall be applied, the second coat shall be applied within time limits recommended by the manufacturer to prevent delamination between coats. A total dry film thickness of not less than 300 microns shall be applied.

The external coating of the pump shall comprise 2 pack epoxy resin to a minimum dry film thickness of 300 microns. The colour of the coating shall be blue.

The coating shall exhibit excellent protection for surfaces of pump and should be resistant against impact and sag. The adhesion or bond of the primer to the metal and the inter coat adhesion of the finish coats and primer shall be perfect.

The coating shall be suitable for drinking water and shall fully comply with BS 6920 standard requirements or approved equivalent.

Proposed coating material must have been applied successfully on at least three similar installations and Contractor shall provide adequate references.

The internal coating system shall be tested in accordance with ISO 2178; it should have a guarantee of at least 7 years under all operating conditions.

#### **4.2.3.10 Nameplate**

Each pump shall be identified by marking and labelling stainless steel nameplate; plate dimensions shall be according to DIN 825 standard. The nameplate shall be securely riveted in a readily accessible position on the pump.

The manufacturer's nameplate shall contain at least the following information:

- Manufacturer
- Pump Serial No.
- Rated Head
- Rated Flow
- Pump Absorbed Power at Duty Point
- Pump Running Speed
- Pump Casing Design Pressure
- Weights of pump & motor & base plate, in kilograms

#### **4.2.3.11 Inspection and Testing**

##### **4.2.3.11.1 General**

Before beginning of any fabrication the Contractor shall submit a detailed quality control and inspection and test plan to the Engineer for approval not less than 10 weeks in advance.

The Contractor shall give proper in-advance notice, not less than 4 weeks to the Engineer when fabrication will start and when tests will be made. All quality control operations carried out by the Manufacturer during fabrication shall form the subject of constantly updated reports.

The Kahramaa / Engineer reserve the right for shop inspection/ stage inspection by their authorised representatives. If witnessing of any tests is not satisfactory and a retest is required, the cost of the witnessed retests shall then be borne by the Contractor.



For each test data, curves, etc. for witnessed test conditions shall be corrected for actual site conditions and submitted for approval by the Kahramaa / Engineer.

The Contractor shall furnish the Engineer with 5 certified copies of the results of all tests prior to shipment of the equipment.

All instruments used during shop tests at manufacturer's premises shall be duly calibrated by recognised laboratories and the calibration certificates shall be inspected and certified by inspectors. The calibration certificates shall not be more than six month old.

Pumps and drives shall be rated for continuous duty and shall be capable of pumping the flow range specified in the data sheet without surging, cavitation, or excessive vibration to the limits specified. All pumps and drives shall be from approved manufacturers.

The pumps shall meet maximum allowable shut-off head, and if dry-mounted submersibles, the maximum allowable required net positive suction head (NPSH) designated in the Project Specification.

The pumps shall not overload the motors for any point on the maximum pump speed performance characteristic curve and the pump operating range, within the limits of stable pump operation, as recommended by the manufacturer, to prevent surging, cavitation, and vibration.

To ensure vibration-free operation, all rotation components of each pumping unit shall be statically and dynamically balanced to BS 6861 and the following requirements shall be met:

- The mass of the unit and its distribution shall be such that resonance at normal operating speeds is within acceptable limits;
- In any case, the amplitude of vibration as measured at any point on the pumping unit shall not exceed the below limits;
- At any operating speed, the ratio of rotation speed to the critical speed of a unit, or components thereof, shall be less than 0.8 or more than 1.3.

Vibration outside the limits as specified shall be sufficient cause for rejection of the equipment.

The completed units, when assembled and operating, shall be free of cavitation, vibration, noise, and oil or water leaks over the range of operation.

All units shall be so constructed that dismantling and repairing can be accomplished without difficulty.

The Vendor shall be responsible for proper operation of the complete pumping system, which includes the pump, motor and associated controls furnished with the pump

The Vendor shall ensure that the controls and starting equipment are suitable for use with the pump motor, taking into account all requirements including starting currents and number of starts per hour.

For the performance curve of the selected pump impeller, the head shall continuously rise as flow decreases throughout the entire curve from run out to shutoff head.

The Vendor shall ensure that drive motors and pumps shall be supplied and tested together by the pump manufacturer, who shall supply full certification for the proper function of the entire pumping system.



The equipment delivered to the Site shall be examined by the Contractor to determine that it is in good condition and in conformance with the approved working drawings and certifications.

#### **4.2.3.11.2 Shop/Factory Tests**

##### **A. Material Tests**

The Contractor/Manufacturer shall submit material test certificates for all pump components in accordance with ISO 10474 3.1B certificate, for the Kahramaa / Engineer approval prior to manufacturing processes.

- The inspection requirements related to the material of construction of the pumps shall include following as a minimum:
- Material checks (chemical composition and physical properties).
- Casting defects and their classification.
- Non-destructive testing (NDT).
- Repairs procedures of castings and welding.

##### **B. Performance Tests**

For each pump coupled to its own motor performance tests in accordance with ISO 9906 Grade 1 shall be conducted.

The test curves shall be plotted together with efficiencies, NPSH, power etc.

Measured values tolerance shall be within acceptable tolerance EN ISO 9906-Grade 1 tolerance grade. However for efficiency, no negative tolerance is acceptable.

Variable speed pumps flow/capacity curve shall be taken also at a reduced speed to be agreed with the Engineer; in addition to, performance tests carried out at nominal pump speed.

##### **C. Factory Tests**

For each pump coupled to its own motor, following tests shall be conducted as minimum:

- Internal/ external coating tests and control
- Bearings temperature measurement;
- Static and dynamic balancing of rotors and impellers of each motor/ pump set;
- Visual inspection including detection of defects, appearance, dimensions etc.

Works tests not specifically mentioned above may be required by Engineer.

The Vendor shall secure from the pump manufacturer certification that the following inspections and tests have been conducted on each pump at the factory, and submit to the Kahramaa prior to shipment:

- The pump casing has been tested hydrostatically to 1.5 times the maximum closed valve pressure;
- The casing shall not show undue deflection at any time during test.
- Impeller, motor rating and electrical connections checked for compliance with the Project Specifications;
- Motor and cable insulation tested for moisture content or insulation defects;



- Prior to submergence, the pump has been run dry to establish correct rotation and mechanical integrity;
- The pump has been run for 30 minutes submerged under a minimum of 2 m water;
- After the operational test (e) above, the insulation tests (b) above has been performed again, and after the performance test (2) below;
- Each pump shall be tested at the factory for performance according to BS EN ISO 9906 Part 1, including tests for following features:
  - Flow;
  - Inlet pressure;
  - Outlet pressure;
  - Motor power;
  - Torque;
  - Efficiency;
  - Net Positive Suction Head (NPSH).
- The Vendor shall secure from the pump manufacturer the following certification and submit to the Kahramaa prior to shipment:
  - Certified copies of the pump characteristic curves and reports generated by the tests described above and as required by BS EN ISO 9906 Part 1;
  - Foundry composition certificates for all major castings (pump case, impeller, motor housing) showing exact material composition and tests conducted to ensure compliance with the pump manufacturer's material specifications;

#### **4.2.3.11.3 Site Acceptance Tests**

Vendor shall provide the services of the pump manufacturer's representative to supervise the installation, commissioning and start-up of the pumping equipment.

The commissioning tests shall be performance and reliability trials, mainly for the purpose of satisfying the Kahramaa that the pump sets have been correctly assembled and installed and that their performance matches that obtained during the manufacturer's works tests. In the event of an unwarranted change in the pump performance characteristics or power consumption, all necessary steps shall be taken as soon as possible to establish the cause and remove the fault. Similar action shall be taken for an undue increase in bearing or gland temperature, increased gland leakage rates, unsatisfactory vibration levels or any other fault or defect in the operation of the pump set.

After complete installation and before commissioning, the Contractor shall carry out site pump set tests in accordance with BS EN ISO 9906 Grade 1, to be witnessed by The Kahramaa/ Engineer personnel, as well as pump and motor, manufacturer's representatives.

The site tests for individual and parallel pump operation shall include but not be limited to the following measured over the entire specified range:

- Rated flow
- Rated differential head
- Shut-off head



- Rated horsepower
- Noise level
- Water leakage measurements
- Bearing temperature measurements
- The site reliability trials shall include the following:
  - A record of bearing and coupling clearance and alignments shall be tabulated to show the "as-built" condition of each pump;
  - A record of all overload, timing relay and oil pressure relays shall be tabulated to show the "as-built" condition of each motor starter
  - All cables shall be "megger" tested to confirm the integrity of the insulation. A tabulated record of results shall be made
  - The control panel shall be statically tested with motors disconnected to confirm the correct sequence of operation
  - Each pump shall be operated individually over the range from closed valve to maximum emergency top water level, on a recirculation basis, using fresh water, and for a minimum of four hours continuously.
  - During this test the following parameters will be recorded:
    - Motor phase currents;
    - Pump output;
    - Ambient and test water temperatures;
    - Motor/pump casing temperature;
    - Power consumed;
    - Power factor;
    - Vibration;
    - Signs of cavitation noise.

The commissioning trials shall extend until each pump unit has run 'continuously' for at least 3 days under all operating conditions. The term 'continuously' shall include running fixed speeds or on a start/stop basis as determined by the control system

The Contractor's supervisory staff, and the pump manufacturer's representative, if required by the Project Specification or the above, shall be present during the period of the tests and trials. The Vendor shall be responsible for any failure of the whole equipment or any part thereof, whether such failure shall be determined by the methods detailed herein or otherwise. If the pump test or trial is interrupted by the Contractor, or through negligence on the part of the Contractor's staff, it shall be completely repeated for the pump set concerned.

The measured values shall be as indicated in the Guaranteed Design Tables and in the pump set data sheets submitted by the Manufacturers/Contractor.

Tolerance factors shall be in compliance with BS EN ISO 9906 Grade 1

In case of non-compliance to this required performance or any problems/defects detected during these tests shall be promptly rectified by The Contractor/Manufacturer at no additional cost to the Kahramaa/ Engineer.



#### **4.2.3.12 Deliverables**

The Contractor shall submit the following technical deliverables, for the Engineer approval, comprises but not limited to minimum of followings:

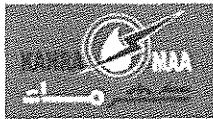
- Pump Technical Datasheet and for auxiliary equipment and instrumentation.
- Pump and Motor Characteristic Performance curves head, efficiency and shaft power and NPSHR values versus flow capacity.
- Parallel pumps operation curves shall be submitted with recorded minimum & maximum flows for all pumps running (variable speed pumps, curves must be submitted showing the performance at minimum of four different speeds)
- Speed-torque curve, Speed – power factor curve, motor thermal capacity etc.
- Detail general arrangement of the complete pump unit (pump and motor) drawings showing dimensions, outlines, sectionals & 3D exploded views, mechanical seals details, allowable forces and moments, instruments P&ID etc.
- Motor water cooling system requirements, calculations and drawings (if needed)
- Complete list of all necessary equipment.
- Complete catalogues of all equipment.
- List of recommended spare parts.
- Details of any special tools required.
- Compliance statement to pump specifications
- Installation instructions including alignment, grouting, connecting of piping, etc. in English and Arabic (if available) in three copies.
- Operating instructions and maintenance manual, illustrated spare parts list, list of recommended spares for five years operation, instructions for daily checking and Maintenance, troubleshooting guide, lubrication and bearing schedule, one month before practical completion (in English and Arabic)
- As-built drawings hard and soft copies in AutoCAD platform.
- Quality control, inspection and test plan
- Method statement for outer and inner surfaces coating as recommended by the manufacturer.

#### **4.2.3.13 Spare Parts and Special Tools**

The Contractor shall include in his bid, as a minimum, consumables and spare parts for commissioning, and spare parts for guarantee period operation. The Contractor/Manufacturer shall guarantee, the availability of spare parts for a minimum duration of 10 years.

For pumps, motors and relevant ancillaries, the Contractor shall provide a spare parts schedule that the equipment manufacturers considers should be kept in stock to cover replacements over a period of 2 years.

The spares shall be packed and sealed in individual boxes to preserve the parts against damage and corrosion over long storage periods. Each package shall be clearly identified as to its contents in English.



The Contractor shall provide a schedule of special tools needed for repair and maintenance of the equipment included in his bid.

The spare parts required shall be in line with QCS2010 Section 9

Minimum spare parts required shall be agreed with Kahramaa.

#### **4.2.3.14 Guarantee and Warranty**

The warranty period for all pump sets shall be two years as defined in General Conditions of Contract. The Contractor shall be responsible for the correction of any defects to the pump sets during the Warranty Period and shall make all necessary repairs and replacements free of charge including labour charges.

#### **4.2.3.15 Retention of pump efficiency for sustainable performance:**

Pumps shall offer sustainable performance over a longer period. Manufacturer shall specify efficiency after defect liability period (2 years), with tolerance limit at the time of the bidding & give warranty for the retention of efficiency after defect liability period (2 years). After completion of defect liability period but before issuing final taking over certificate, Site tests shall be performed as explained above, to ascertain the performance with agreed tolerance. In case of non-compliance to this required performance, the manufacturer/contractor shall take corrective actions as necessary to improve the performance of pumps at his cost. Otherwise Kahramaa may carry out such rectifications from other contractor

### **4.3 VALVES**

#### **4.3.1 General**

##### **4.3.1.1 Scope of Specification**

The Works included in this specification consist of the design, manufacture, witness of inspection by the Engineer's representative at the place of manufacturer, supply, delivery to site, off-loading, storage, protection, on site storage, site transportation, erection, testing, commissioning of all the isolation, regulation, non-return, and control valves detailed in the following clauses.

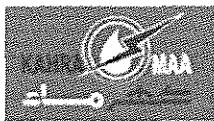
This specification document comprises the minimum technical requirements for the Works and Compliance with this specification shall not relieve the Contractor from any of his contractual obligations and responsibilities.

The Contractor shall notify the Engineer of any conflict between this specification, the codes and standards and any other specification included as part of the contract documents applicable.

Deviations and conflicts from this specification shall be listed in details and submitted for review and approval. Any conflicts shall be raised by the Contractor in tender stage and be resolved in writing by Kahramaa or the Engineer.

Any exception of this specification and referenced documentation shall be raised by the Contractor and approved by the Engineer in writing.

##### **4.3.1.2 Abbreviations**



ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BS	British Standard
CPS	Corridor Pumping Station
dB	Decibel
DI	Ductile Iron
DIN	Deutsches Institut für Normung e.V. (German Institute for Standardisation)
DN	Diameter Nominal
EN	European Norm
FBE	Fusion Bonded Epoxy
ISO	International Organization for Standardization
IP	Internal Protection
KM	Qatar General Electricity & Water Corporation (KAHRAMAA)
MAOP	Maximum Allowable Operating Pressure
PTFE	Poly Tetra Flouro Ethylene (Teflon)
PN	Nominal pressure
QCS	Qatar Construction Specification
SS	Stainless Steel

#### **4.3.1.3 Operating Conditions**

##### **A. Medium Characteristics**

The valves shall be suitable for handling desalinated potable water with chlorine/Chlorine dioxide content within the parameters of the Kahramaa water quality standards.

##### **B. Environmental Conditions**

The valves and associated equipment shall be designed and be suitable for operation in the climatic conditions of state of Qatar (tropical weather, with excess heat dust and humidity at time). Refer to Appendix A1 section 1.9.

##### **C. Standards and Codes**

The works, equipment and materials shall be designed, manufactured and erected according to the following applicable codes, standards (in their latest edition where not otherwise specified)

- Qatar General Electricity & Water Corporation: Standards, Specifications and Regulations
- Qatar Construction Specification (QCS 2010)
- BS EN 1563 Founding. Spheroidal graphite cast iron



- EN 1092 Circular flanges for pipes, valves and fitting
- BS EN 10088 (all parts) stainless steels
- ISO 5752 Metal valves for use in flanged pipe systems. Face-to-face and centre-to-face dimensions
- BS EN 12516-3 Valves Shell design strength. Experimental method
- BS EN 558 Industrial valves —Face-to-face and centre-to-face dimensions of metal valves for use in flanged pipe systems
- BS EN 12570 Industrial valves: Method for sizing the operating element
- BS EN 19 Industrial valves. Marking of metallic valves
- BS EN 1171 Cast iron gate valves
- DIN EN 895 Destructive Testing of Welds in Metallic Materials, Transverse Tensile Test
- EN 10204: Metallic Products – Types of Inspection Documents
- BS 970 Part 1 General inspection and testing procedures and specific requirements for carbon, carbon manganese alloy and stainless steel
- BS 6920 Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Methods of test. Odour and flavour of water. General method of test
- Other internationally accepted standards, which ensure a quality equal to or higher than the standards mentioned above, if an edition in the English language is available. Then Contractor shall provide a copy thereof and provide evidence that the proposed standard will ensure a quality equivalent or higher than the standards referred in this document.

#### **4.3.1.4 Valve Ends**

All valves shall be flanged in accordance to BS EN 1092-2 PN16.

#### **4.3.1.5 Design Pressure**

Valves shall be designed for use with nominal pressure of 16 bar (PN16).

#### **4.3.2 Gate Valves**

##### **4.3.2.1 Construction**

Gate manufactured in accordance with BS EN 1171 with metal seated and BS 5163 with resilient sealing / BS EN 558/ ISO 5752 Series 3 Gate valves shall be with inside screw, solid wedge and shall be of non-rising stem type.

All valves below shall be of the resilient seat type.

All component parts of the valve body i.e. bonnet and stem seal housing shall be bolted together.

Valves materials shall be free from any defects, selected to confirm its suitability and corrosion resistance for the long term use under the specific operating conditions. Valves construction materials shall be as per below table.



Item	Material
Body and flanges	Ductile Iron GGG50 (EN GJS-500-7 -) as per EN 1563.
Disc/ Wedge/gate	GGG-50 (EN GJS-50-7 as per EN 1563
Stem	Stainless steel Grade 1.4401
Stem nut	Replaceable gunmetal BS 1400 LG2
Seat/Facing of disc or body for metal seated	Renewable bronze to BS EN 1982 or Stainless steel Grade 1.4401

#### 4.3.2.2 Wedge

For the resilient type, the wedge shall be completely vulcanized by EPDM and coupled to the valve stem by gunmetal or dezincification resistance brass nut slide into the specifically designed slot hole in wedge or rigidly fastened into the wedge body by forging before rubber vulcanization. Rubber material shall be of "EPDM EDK-70" and the minimum thickness shall be 1.5 mm, and all sealing surfaces not less than 4.0 mm.

For the metal seated the valve bodies shall be fitted with renewable gunmetal machined gate slides and the gates shall be with renewable hard bronze shoes accurately machined to reduce sliding friction.

Seat-rings shall be interchangeable. No lubrication of seating surfaces shall be allowed.

#### 4.3.2.3 Stem

Valve stems shall be machined stainless steel 1.4404 with a machine cut robust trapezoidal or square form thread.

Stem seals shall be of the stuffing box and gland form accessible for maintenance without removal of the valve from service. Stem seals on valves below 350mm diameter may be either stuffing box and gland or 'O' ring type.

#### 4.3.2.4 Lifting Lugs and Resting Legs

Lifting lugs shall be provided for all valves. Resting/mounting legs shall be provided as necessary especially for valves above 350 mm bore.

#### 4.3.2.5 Hand Wheels

Hand wheels shall be manufactured with forged steel or malleable iron, unless otherwise recommended by the manufacturer, marked "Open" and "Closed" with arrow in appropriate directions. Minimum size of the hand wheel shall be in accordance with EN 12570; the maximum diameter of valves hand wheel shall be 800 mm.



The operating force shall be limited to 245 N. A gearing shall be supplied where necessary and if the operating force is greater than 245 N.

Valves hand wheel shall incorporate a locking bracket for use with a padlock or padlock and chain.

#### **4.3.2.6 Operating device**

Generally, all valves shall be operated by an electric actuator, unless otherwise shown on the Contract drawings.

The valve/actuator attachment shall be in accordance with EN ISO 5210. For actuator detailed specifications refer to Section 4.4

#### **4.3.2.7 Accessories**

Valves shall be capable of being locked in their operating and isolation positions to prevent unauthorised use of the valves.

The valves shall be supplied complete with all the required joint accessories, gaskets, bolts, nuts, washers, etc. for both flanges of each valve.

Valves assembling nuts, bolts, and washers for all types of joints shall be stainless steel 316 Grade.

Valves external connection nuts, bolts, and washers for all types of joints shall be mild steel with hot dipped zinc galvanized minimum 50 micron thick.

All bolt heads and nuts shall be hexagonal. Anchor bolts shall be furnished with two nuts each.

#### **4.3.2.8 Fail Safe**

Fail safe philosophy shall be mentioned in details in Operation Philosophy. A detailed list of valves including its fail safe positions is enclosed in tender documents.

Generally, shut off fail safe shall be designed for drop tight shut off under flow from either direction at a differential pressure of 1.1 times of the rated design pressure.

#### **4.3.3 Butterfly Valves**

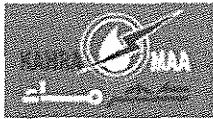
##### **4.3.3.1 Construction**

All butterfly valves shall be Double/Triple Offset type, with EPDM rubber minimum Thickness 3mm, clockwise closing, manufactured and tested in accordance with BS EN 593. Flanges face to face in accordance with B.S 558 series 13/14 table 2

All the quick closing valves fall under this category.

All component parts of the valve body i.e. bonnet and stem seal housing shall be bolted together with proper rubber gasket.

Valves materials shall be free from any defects, selected to confirm its suitability and corrosion resistance for the long term use under the specific operating conditions.



Valves construction materials shall be as per below table:

Item	Material
Body and flanges	Ductile Iron GGG50 (EN GJS-500-7 as per EN 1563.
Disc	Ductile Iron GGG50 (EN GJS-500-7 as per EN 1563. It shall be of solid one piece casting (non-hollow)
Disc Seal	EPDM with stainless steel 1.4571 retaining ring
Seat	High-alloy weld overlay, micro finished
Gasket	Rubber (cotton reinforced)
Shaft Bearing	Self-lubricating PTFE or Zinc free bronze, with EPDM 'O' ring seals
Shaft	Stainless Steel 1.4462, 100% dry shaft design
Retaining Ring	Stainless Steel 1.4571

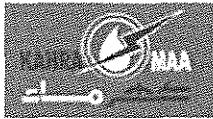
#### 4.3.3.2 Disc

The disk shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The disk shall be contoured to ensure the lowest possible resistance to flow and shall be suitable for throttling operation with minimum vibration. The disc material shall be of ductile iron EN 1563, , EN-GJS-500-7. The disc closure seating shall be resilient type.

The valve disk shall rotate through an angle between 0° degree and 90° degrees inclusive, from a fully opened or fully closed position and the reverse. The butterfly valves shall be suitable for horizontal shaft installation and shall be capable of satisfactory operation with the direction of flow in principle direction. Disc edges shall be machined with rounded corners and shall be polished to a smooth finish and the seat shall be designed so as to allow the valve disc to close at an angle normal to the axis of the pipe. Adjustable mechanical stops shall be provided to prevent over travel of the valve disc. The stops, shaft, and disc fixing shall be capable of absorbing full operating torque, with a minimum design safety factor of five.

#### 4.3.3.3 Shaft

The shaft shall be of Duplex Stainless Steel Grade 1.4462 designed to withstand the maximum torque that will be imposed by the operator. It may be in one piece or attached as two stub ends on opposite sides of the disk. The means of attachments of the shaft to the disk shall be by using fixings of pattern which precludes the assembly becoming



loose in operational service. Self-lubricating PTFE (Poly Tetra Flouro Ethylene) or zinc free bronze faced bearings with EPDM (Ethylene Propylene Diene Monomer) 'O' rings seals shall be provided. The sealing ring shall be attached to the disc edge circumference by a retaining ring.

#### **4.3.3.4 Lifting Lugs and Resting Legs**

Lifting lugs shall be provided for all valves. Resting/mounting legs shall be provided as necessary especially valves above 350 mm bore.

#### **4.3.3.5 Hand Wheels**

The valve shall be provided with a suitable hand wheel of adequate diameter for the duty required. The valve shall be provided also with extension spindles stainless steel 1.4404. Headstocks and foot brackets shall be provided where specified. Headstocks shall incorporate a valve position indicator. The head stock shall be manufactured in ductile iron to EN 1563, , EN-GJS-500-7. The operating force shall be limited to 245 N. A gearing shall be supplied where necessary and if the operating force is greater than 245 N.

Valves hand wheel shall incorporate a locking bracket for use with a padlock or padlock and chain.

The valve shall have necessary provision and the facility to be coupled with an electrical actuator, if required at a later date.

#### **4.3.3.6 Operating Device**

Generally, all valves shall be operated by an electric actuator, unless otherwise shown on the Contract drawings.

The valve/actuator attachment shall be in accordance with EN ISO 5210. For actuator detailed specifications refer to Section 4.4.

All quick closing valves shall be operated by hydraulic actuators of weight loaded hydraulic unit type with hydraulic pump unit, hydraulic hand pump, closing counter weight, and hydraulic cylinder with multiple closing step. Refer to the data sheets for more details Accessories

Valves shall be capable of being locked in their operating and isolation positions to prevent unauthorised use of the valves.

The valves shall be supplied complete with all the required joint accessories, gaskets, bolts, nuts, washers, etc. for both flanges of each valve.

Valves assembling nuts, bolts, and washers for all types of joints shall be stainless steel 1.4401.

Valves external connection nuts, bolts, and washers for all types of joints shall be mild steel with hot dipped zinc galvanized, minimum 50 micron thick.

All bolt heads and nuts shall be hexagonal. Anchor bolts shall be furnished with two nuts each.

#### **4.3.3.7 Fail Safe**

Fail safe philosophy shall be mentioned in details in Operation Philosophy; a detailed list of valves including its fail safe positions is enclosed in tender documents.



Generally, shut off fail safe shall be designed for drop tight shut off under flow from either direction at a differential pressure of 1.1 times of the rated design pressure.

#### **4.3.4 Check Valves**

##### **4.3.4.1 Construction**

The design of the valve body shall be such that there is adequate clearance around the back of the door to minimize jamming by rags and debris. Stops shall be provided to limit the back lift of the disc and shall be positioned to prevent fouling.

The hinge pin/shaft shall be stainless steel 1.4404. Both disc and lever shall be positively and securely fixed to the hinge pin/shaft. Grub screws pins (parallel to taper) or clamps will not be acceptable. All internal fixing devices shall be of stainless steel. Valves shall carry identification marks in accordance with BS 5153. All nuts and studs subject to vibration shall be fitted with spring washers or locking tabs.

Check valves below the size DN 300 mm (inclusive) shall comply with BS 5153 standard requirement. Valves shall be swing, non-slam, and noiseless type.

Check Valves construction materials (for DN≤300) shall be as per below table:

<b>Item</b>	<b>Material</b>
Body, bonnet, weight and hinge	Ductile Iron GGG50 (EN GJS-500-7) as per EN 1563
Flap/disc Ductile	Ductile Iron GGG50 (EN GJS-500-7 -) as per EN 1563
Sealing (for metal seated)	Dezincification resistant brass
Lever	Carbon Steel
Shaft/Pin	Stainless steel 1.4404

Check Valves of sizes DN 350 mm and above shall be high dynamic, spring loaded, non-slam, noise less, long pattern, metal seated type. The design of the valve internal parts shall allow the disc to respond in less than 0.15 second to any flow changes. The single helical spring shall be fully shielded from the process stream by the central flow diffuser. The metal to metal sealing shall achieve tight shut off with 100% reliability.

Check Valves construction materials (for DN≥350) shall be as per below table:

<b>Item</b>	<b>Material</b>
Body, bonnet, weight and hinge	Ductile Iron GGG50 (EN GJS-500-7- - as per EN 1563.
Disc	ASTM A 351 CF 8m



Spring	Dezinification resistant brass.
Seat	Carbon Steel

#### 4.3.4.2 Lifting Lugs and Resting Legs

Lifting lugs shall be provided for all valves. Resting/mounting legs shall be provided as necessary especially valves above 350 mm bore.

#### 4.3.5 Air Valves

##### 4.3.5.1 Construction

Air release valves shall be designed to meet the following conditions automatically:

- Discharge air during charging of the pipework
- Admit air during emptying of the pipework
- Discharge air accumulated at local peaks along pipelines under normal operating conditions.

Valves construction materials shall be as table below:

Item	Material
Body, cover and baffle	Ductile Iron GGG50 (EN GJS-500-7as per EN 1563.
Float	Stainless steel 13% chromium or light alloy coated with EPDM or Polypropylene disc.
Guides, seats, bushings, screws and other internals	Stainless steel 1.4404
Spindle	Stainless steel 1.4404

##### 4.3.5.2 Double Orifice Air Valve Type

Double air valves are a combination of both large and small orifices and are used for bulk removal, inlet of air as well as removal of air under pressure.

The large orifice shall be sealed by a float and the valve body shall be designed to avoid premature closing of the valve by the discharging air. The small orifice shall be sealed by a float at all pressure above atmospheric except when air accumulates in the valve body. Body ends shall be flanged with raised faces and drilling standards shall be as per the data sheets.

##### 4.3.5.3 End Connection



Between the branch-off tee and air release valve a flanged short bodied isolating valve shall be installed to facilitate the removal or replacement of the air release valve without closing the valves on the mainline. Regardless of any built in isolation means in air release valve. Material specification for this isolation valve shall in accordance with Section 4 of this specification.

#### **4.3.6 Flow Control Valve**

Flow control valves shall be axial flow non-diaphragm type. Relation of valve capacity Cv with % opened shall be linear with approximately 50% Cv, 50% opened. Valves shall be designed for cavitation-free operation in all modes of operation. The valves shall be leak rate A as per EN12266. The valves shall be capable of bubble tight sealing against 16 bar operating pressure.

The flow control valves are manufactured in accordance with EN558-1 Basic Series 15 and shall be flanged to EN 1092-2 PN16. Control valves shall be electrically activated with modulating type actuator complete with a positioner or electronic controller to provide full programmable monitoring and control the flow. The actuators shall be provided in accordance with Section 21, Part 33 of QCS 2010. The power connection to the actuator shall be 240V. Profibus and HART communication port shall be provided as required by the SCADA communication system. The noise level shall not exceed 85dBA at 1m distance from the valve.

Inside and outside valves shall be protected with nontoxic fusion-bonded epoxy (powder coating), minimum 300 microns DFT at any point. Axial type flow control valve construction materials shall be as per below table:

<b>Item</b>	<b>Material</b>
Body	Ductile Cast Iron EN 1563, EN-GJS-500-7
Piston	Stainless Steel 316L
Shaft	Duplex Stainless Steel 1.4462
Regulating cylinder	Stainless Steel 316L
Piston guides	Bronze
Bearing bush	Bronze
Valve Sealing	EPDM
Bolts	Bolts for all flanges shall be mild steel with hot dipped galvanising, minimum 70 micron thickness

#### **4.3.7 Pressure Sustaining Valve**

The pressure sustainable valve shall be of the pressure compensated globe type diaphragm operated complete with external hydraulic relay system and designed to automatically sustain a predetermine pressure of 1.1 bar immediately upstream its position.



The pressure sustaining valve shall be a single-seated, line pressure operated, diaphragm actuated, pilot controlled globe valve. The valve shall seal by means of a corrosion-resistant seat and a resilient, rectangular seat disc. These, and other parts, shall be replaceable without removing the valve from the line. The stem of the main valve shall be guided top and bottom by integral bushings. Alignment of the body, bonnet and diaphragm assembly shall be by precision dowel pins. The diaphragm shall not be used as a seating surface, nor shall the pistons be used as an operating means. The pilot system shall be furnished complete and installed on the main valve. It shall include a closing speed control, Y-strainer, pilot check valves and isolation ball valves.

Inside and outside valves shall be protected with nontoxic fusion-bonded epoxy (powder coating), minimum 300 microns DFT at any point. Pressure sustain valve construction materials shall be as per below table:

Item	Material
Body,	Ductile Iron GGG50 (EN GJS-500-7) as per EN 1563
Trim ported guide and seating	Gunmetal to B.S 1400 LG 2C
Sealing	Rubber
Pilot valve (control valve)	Stainless Steel 316
Pilot part (fittings)	Stainless Steel 316
Indicating rod	Stainless steel 316

#### **4.3.8 Flap Valve**

##### **4.3.8.1 Construction**

Flap Gates shall be constructed entirely of stainless steel. All hardware shall be stainless steel and shall be operable at differential head of 0.1 m

The wall thimble shall be stainless steel and supplied by the gate manufacturer. Material thicknesses shall be according to the manufacturer's recommendations.

The frame shall be made of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be of the flange back design suitable for mounting on a concrete wall (CW), concrete wall with extra-wide flange (CWX), round manhole (RM), round manhole with extra-wide flange (RMX), wall thimble (WT), or standard flange (SF).

The gate cover shall be made of structural members or formed plate adequately reinforced to withstand the maximum specified seating head without distortion.

Seals shall be made of resilient neoprene attached to the body by means of a retainer ring for flaps up to 24" (610 mm). Seals shall be made of EPDM attached to the frame with a stainless steel retainer for flaps over 24" (610 mm).

Hinges shall consist of a stainless steel pin and shall have a UHMWPE bushing.



Hinge arms shall be made of structural members or formed plates. Gates 30" (762 mm) and over in diameter shall have a 2-hinge arm arrangement, with 2 pivot joints per arm, an adjustable lower pivot with limited rotation and an adjustable upper hinge lug arrangement to permit adjustment of the gate opening sensitivity to unseating head

#### Material Chart

Part	Material
Body, cover, hinges, hinge arm	Stainless steel ASTM A-240 Type 316L
Hinge bushing	Ultra high molecular weight polyethylene (UHMWPE) ASTM D-4020
Seal for flaps over 24" (610 mm)	EPDM ASTM D-2000
Fasteners	ASTM F593 and F594 GR1 for Type 304 and GR2 for type 316

#### 4.3.8.2 Operation

Doors shall maintain a closed seal at normal operational condition Installation Generally Valves shall be adequately supported independently of the pipes to which they are connected and shall be supplied with mounting feet (with drilled holes to accommodate anchor bolts) especially valves above 350 mm bore.

All valves operation level shall be 0.9 to 1.2 m above floor level; if necessary a portable step platform shall be provided as an operation platform or extended spindle installations provided.

#### 4.3.9 Coating

The internal and external surfaces of the valve and the disc shall be blast cleaned to SA 2.5, ISO 8501 standards and coated with fusion bonded epoxy coating system to a dry film thickness of 300mm at any point. The maximum dry film thickness shall be as per paint manufacturer recommendations.

Internal linings shall be suitable for the transport of potable water for human consumption and shall comply with requirements of the BS 6920 standard or approved equivalent.

#### 4.3.10 Nameplate

Each valve shall be identified by marking and labelling stainless steel nameplate according to BS EN 19. The nameplate shall be securely riveted in a readily accessible position on the valve.

The manufacturer's nameplate shall contain at least the following information in English language:

- I. Manufacturer's name and/or trademark.



- II. Manufacturing Standards Number.
- III. Serial No.
- IV. Material type
- V. Size of valve in mm.
- VI. Hand wheel Direction of Rotating
- VII. Pressure rating in Bars
- VIII. PN/Class designation.
- IX. Year of manufacture.
- X. Arrow for direction of flow
- XI. Weights in kilograms

Each valve design for uni-directional flow shall have an arrow embossed or cast on the valve body clearly indicating the required flow direction.

#### **4.3.11 Inspection and Testing**

##### **4.3.11.1 General**

Before beginning of any fabrication the Contractor shall submit a detailed quality control and inspection and test plan to the Engineer for approval not less than 10 weeks in advance. The Contractor shall submit detailed method statement for all tests, for Kahramaa/the Engineer approval before initiating any test.

The Contractor shall give proper in-advance notice, not less than 4 weeks to the Engineer when fabrication will start and when tests will be made. All quality control operations carried out by the Manufacturers during fabrication shall form the subject of constantly updated reports.

Kahramaa/the Engineer reserves the right for shop inspection/stage inspection by their authorised representatives. If witnessing of any tests is not satisfactory and a retest is required, the cost of the witnessed retests shall then be borne by the Contractor.

The valves shall be inspected and tested in accordance with the requirements of applicable BS EN 12516, BS EN 1074 and project specifications.

The Contractor shall furnish the Engineer with 5 certified copies of the results of all tests prior to shipment of the equipment.

Instruments used during shop tests at manufacturer's premises shall be duly calibrated by recognised laboratories and the calibration certificates shall be inspected and certified by inspectors.

In case of non-compliance to this required performance or any problems/defects detected during these tests shall be promptly rectified by the Contractor/Manufacturer at no additional cost to Kahramaa.

Repairs and material replacements shall be only conducted if authorized by Kahramaa/Engineer.

##### **4.3.11.2 Shop / Factory Tests**

###### **A. Material Tests**



The Contractor/Manufacturer shall submit material test certificates for all valves components in accordance with EN 10204, for Kahramaa/ the Engineer approval prior to manufacturing processes.

**B. Visual Inspection**

The valves shall be visually inspected regarding dimensions, materials and workmanship by an inspector approved by the Engineer. Valve bodies shall be sound, free from cracks, indentations, spalling, scale, patching or other defects detrimental to their use.

**C. Hydrostatic Test**

The tests shall be carried out in accordance with applicable standards and codes for the particular valves. Each valve shall be subject to hydrostatic body pressure test of 1.5 design pressure and disk strength/ leakage test 1.1 times the design pressure.

No visible leakage through the shaft seal or any other part of the body or pressure drop shall be noticed during test conditions. The exterior of the valve shall remain completely dry throughout the test.

If any leak noticed from the valve body, the body shall be rejected. For any other defects the Contractor shall inform the Engineer and repair the defects only after Kahramaa/the Engineer's approval. Then a new hydrostatic shell test shall be carried out after any repair.

A type 3.2 factory test certificate, as per EN 10204, shall be issued for each valve giving its serial numbers. This certificate shall be submitted to Kahramaa/the Engineer at the time of supply.

Test data and pressure shall be recorded during the entire testing time, minimum 10 minutes. The test reports shall clearly show all information identifying in particular, for each test the following:

- I. Nominal diameter
- II. Pressure rating
- III. Identification item / tag number of the valve
- IV. Test type
- V. Duration
- VI. The signature (clearly readable) of the person in charge of the test.

**D. Testing of Internal Lining and External Coating**

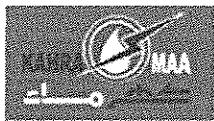
The internal lining and external coating film thicknesses shall be inspected by means of a non-destructive dry film thickness gauge, e.g. electromagnetic gauge. The DFT shall not be less than the minimum required.

In addition to above lining and coatings shall comply with the following as a minimum:

Adhesion Test: Adhesion of coating to metal shall not be less than 12 N/mm<sup>2</sup>

Holiday Test: Porosity of coating shall be "zero" on 3 kV DC tester

Hardness Intrinsic: Rockwell hardness shall be between 50 – 60



**Impact Resistance:** For applying of impact energy of 5NM on coating the cracks should not develop, when tested by 3 kV DC tester

**E. Operating Test Procedures**

Each valve shall be tested on hand operation under the above previous mentioned design pressure of the valve.

The valve shall be easily opened and closed without any excessive efforts/forces, both for the operator and for the valve parts.

The tests shall be repeated with the aid of the motor operator, if included, for at least 5 openings and 5 closings without interruption in order to verify the correct operation including the specified opening/closing time. All parts shall fit and locate correctly, and operate freely.

**F. Number of Valves to be tested**

All supplied valves shall be tested in the presence of Kahramaa/the Engineer, unless otherwise declared by Kahramaa/the Engineer.

**4.3.11.3 Site Acceptance Tests**

After complete installation and before commissioning, the Contractor shall carry out typical operation site tests in accordance with EN 1074 to be witnessed by Kahramaa/the Engineer personnel, as well as the valve and actuator manufacturer's representatives.

**4.3.12 Deliverables**

The Contractor shall submit the following technical deliverables prior to commencement of production, for Kahramaa/the Engineer approval, comprises but not limited to minimum of followings:

- Valves, gearbox and actuators Technical Datasheets.
- Drawings showing the exact dimensions of all valve components including the distance between the valve and the actuator / hand-wheel / gearbox.
- Material specification of all pressure and non-pressure carrying components
- Certificates on the suitability of materials
- Complete list of all necessary equipment.
- Complete catalogues of all equipment.
- List of recommended spare parts.
- Details of any special tools required.
- Compliance statement to specifications
- Installation and assembly instructions in English and Arabic (if available) in three copies.
- Operating instructions and preventative/corrective maintenance manual, illustrated spare parts list, instructions for daily checking and Maintenance, troubleshooting guide in English and Arabic
- Quality control, inspection and test plan



- Method statement for outer and inner surfaces coating as recommended by the manufacturer.
- For each actuator, detailed technical sizing sheets includes : currents at the specified voltage corresponding to locked rotor, maximum seating torque, average running load, and speed and full information concerning actuator dimensions and weights shall be provided.

#### **4.3.13 Spare Parts and Special Tools**

The Contractor shall include in his bid, as shown on the BOQ spare parts for commissioning, and spare parts for guarantee period operation. The Contractor/ Manufacturer shall guarantee the availability of spare parts for a minimum duration of 10 years.

The Contractor shall provide a spare parts schedule that the valves manufacturers considers should be kept in stock to cover replacements over a period of 2 years.

The spares shall be packed and sealed in individual boxes to preserve the parts against damage and corrosion over long storage periods. Each package shall be clearly identified as to its contents in English.

The Contractor shall provide a schedule of special tools needed for repair and maintenance of the equipment included in his bid.

#### **4.3.14 Guarantee and Warranty**

The warranty period for all of the valves sets shall be 2 year as defined in General Conditions of Contract .The Contractor shall be responsible for the correction of any defects to the valves or its associated ancillaries during the Warranty Period and shall make all necessary repairs and replacements free of charge including labour charges.

#### **4.3.15 Shipping**

Each valve shall be drained of any test liquid. The body ends shall be protected to prevent the introduction of foreign materials and moisture.

In the case of polymeric or elastomeric seated valves the seatings shall be protected from ultra violet light and not in compression. All other valves shall be delivered with the disc/gate in the closed position.

In addition to the factory-applied internal lining and external coating specified above, suitable rust inhibitor (paints, grease etc.) shall be applied in order to prevent corrosion during transport, storage, handling and hydrostatic tests on parts subject to corrosion, internal and exposed surfaces.

Each valve including actuators shall be shipped as fully assembled units in separate packages, but any external auxiliary piping, valves and fittings shall be shipped securely attached to the valve for installation by the Contractor. Where this is not possible due to size or load etc. the actuators shall be installed on site.

### **4.4 Valve Actuators**

#### **4.4.1 General**

##### **4.4.1.1 Scope of Specification**



The Works included in this specification consist of the design, manufacture, witness of inspection by the Engineer's representative at the place of manufacturer, supply, delivery to site, off-loading, storage, protection, on site storage, site transportation, erection, testing, commissioning of all the valve actuators

The provisions of this Section shall apply to all valves, except where otherwise indicated in the Contract Documents.

This specification document comprises the minimum technical requirements for the Works and Compliance with this specification shall not relieve the Contractor from any of his contractual obligations and responsibilities.

The Contractor shall notify the Engineer of any conflict between this specification, the codes and standards and any other specification included as part of the contract documents applicable.

Deviations and conflicts from this specification shall be listed in details and submitted for review and approval. Any conflicts shall be raised by the Contractor in tender stage and be resolved in writing by Kahramaa or the Engineer.

Any exception of this specification and referenced documentation shall be raised by the Contractor and approved by the Engineer in writing.

#### **4.4.1.2 Abbreviations**

IEC	International Electro technical Code
DN	Diameter Nominal
EN	European Norm
ISO	International Organization for Standardization
IP	Internal Protection
KM	Qatar General Electricity & Water Corporation (KAHRAMAA)
PN	Nominal pressure
QCS	Qatar Construction Specification
SS	Stainless Steel

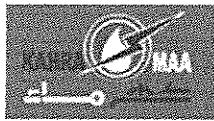
#### **4.4.1.3 Operating Conditions**

##### **A. Medium Characteristics**

The valves shall be suitable for handling desalinated potable water with chlorine/Chlorine dioxide content within the parameters of the Kahramaa water quality standards.

##### **B. Environmental Conditions**

The valves and associated equipment shall be designed and be suitable for operation in the climatic conditions of state of Qatar (tropical weather, with excess heat dust and humidity at time). Refer to Appendix A1 section 1.9.



### C. Standards and Codes

The works, equipment and materials shall be designed, manufactured and erected according to the following applicable codes, standards (in their latest edition where not otherwise specified)

- Qatar General Electricity & Water Corporation: Standards, Specifications and Regulations
- Qatar Construction Specification (QCS 2010)
- IEC 60038 Standard voltages
- IEC 60059 Standard current ratings
- IEC 60617 Recommended graphical symbols
- IEC 60947 Low-voltage motor starters
- IEC 61020 Electromechanical switches for electronic equipment
- IEC 60529 Classification of degrees of protection provided by enclosures
- IEC 60034-1 Rating and performance
- IEC 60034-5 Degrees of protection by enclosure for rotating machinery
- IEC 60034-8 Terminal marking and direction of rotation of rotating machines
- Other internationally accepted standards, which ensure a quality equal to or higher than the standards mentioned above, if an edition in the English language is available. Then Contractor shall provide a copy thereof and provide evidence that the proposed standard will ensure a quality equivalent or higher than the standards referred in this document.

#### 4.4.2 Manual Actuators

##### 4.4.2.1 General

Unless otherwise indicated, valves shall be furnished with manual actuators. Valves in sizes up to and including DN100 shall have direct acting lever or handwheel actuators of the Manufacturer's best standard design.

Larger valves shall be equipped with worm gear or sliding crank gear box device Gear box shall be of

- Standard ratio 1.1-10.1 (as specified)
- Torque ranges 400-40,000 Nm.
- Thrust range 4,000-250,000 daN

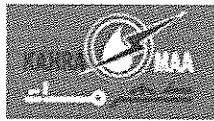
##### 4.4.2.2 Construction

Gear box shall be of following materials: -

Body & body cover                      Ductile Iron GGG 50SG

Bevel gear-shaft                      Steel / Carbon steel

Gear                                      SG Iron, BS EN 1563 Grade 700-2



#### **4.4.3 Electrical Actuators**

##### **4.4.3.1 General**

The electric motor actuator for valves shall be manufactured as per standard and proven design ensuring maximum safety to personal, economic operation and maximum service life. The actuators shall be suitable for nominal 415 V, 3 phase , 50 Hz power supply and shall include motor integral reversing starter, local control facilities and terminals for remote control and indication connections.

The actuators shall be sized to ensure valve operation at the specified differential pressure. Torque setting shall be 40 to 100% rated torque

Motor actuators shall be capable of continuous operation at their full current and voltage ratings without detriment or malfunction at system continuous deviation of up to and including the following percentages of the normal values.

- Voltage  $\pm 10\%$
- Frequency  $\pm 5\%$
- Absolute total voltage and frequency variation 5%

##### **4.4.3.2 Construction**

The actuator shall be one integral unit comprising the following :

- Squirrel cage motor
  - Reversing Contactor Starter
  - Local Control Facilities (Open/Stop/Close)
  - Remote Control Facilities (Open/Stop/Close)
  - Remote Indication Facilities (Open/Close/Fault)
- A. Terminals and terminal box for incoming and outgoing cables Motor

The electric motor shall be 3 phase squirrel cage, Class F insulated, with a time rating of 15 minutes at 40°C or twice the valve stroking time, whichever is longer, at an average load of at least 33% of maximum valve torque.

Protection of the motor shall be minimum as follows.

Motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve;

Protection against overheating;

Single phasing and incorrect phase sequence protection.

B. Gearing

The gearing shall be totally enclosed in an oil or grease-filled gearcase suitable for operation at any angle. All gearing must be of metal construction. The drive shall incorporate a lost-motion hammerblow feature. Design shall ensure that gear case can be opened for inspection or disassembled without releasing the stem thrust or taking the valve out of service



**C. Hand wheel**

For emergency operation hand wheel shall be provided. The hand wheel drive shall be mechanically independent of the motor drive and design shall be such to permit operation within reasonable time.

**D. Position Indication**

For remote indication of the any position of the valve, four contacts shall be provided. The contacts shall be rated at 5A, 250 V AC, 30 V DC. As alternative, any of the aforementioned contacts shall be selectable to signal one of the following:

Closing

Valve operation(movement)

Motor trip on torque in the mild level

Motor stalled

**E. Hand wheel operation**

The actuator shall include a position indicator with a display from fully open to fully close. Lights corresponding to OPEN, CLOSED and INTERMEDIATE/ FAULT position shall be indicated on the actuator.

**F. Integral Starter and Transformer**

Each valve actuator shall be supplied with built-in reversing contractor starter, control transformer and local control suitably housed to prevent breathing and condensation. The starter shall be designed for 60 starts per hour and shall comprise mechanically and electrically interlocking reversing contactors rated in accordance to motor size, with coils fed from a control transformer with suitable rating.

The common connection of the contactor coils shall be grounded at the transformer so that the contactors may drop out in the event of a leakage to ground. The primary winding shall be separated from the secondary winding by a grounded screen. The control transformer shall have tapings as

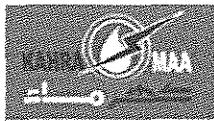
- 120 AC energisation of contactor coils.
- 24V DC output for remote controls
- supply for all the internal electrical circuits.

Primary and secondary windings shall be protected with easily replaceable cartridge type fuses.

**G. Integral Pushbuttons and Selector**

Integral to the actuator shall be local control for OPEN, CLOSE and STOP, and Local/Remote selector switch pad lockable in any one of the following positions:

Local control only, off (no electrical operation) remote control plus local stop only. It shall be possible to select maintained or non-maintained local control.



The local control shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

#### H. Control Facilities

Wiring and terminals shall be provided in the actuator for the following control functions:

Removable links for substitution by internal interlocks to inhibit valve opening/closing.

Connections for external remote controls fed from an internal 24V DC supply and/or from an external supply of (min. 12V, max. 120V) to be suitable for any one or more of the following methods of control :

- OPEN, CLOSE AND STOP.
- OPEN AND CLOSE
- Two-wire control, energize to close (or open), de-energize to open (or close).

Selection of maintained or push-to-run control for modes (a) and (b) above shall be provided and it shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 1.1kV.

#### I. Monitoring Facilities

Facilities shall be provided for monitoring actuator operation and status. Monitor (status) relay, having on change over contact, the relay being energized from the control transformer only when the Local/Off/Remote selector is in the remote position to indicate that the actuator is available for remote operation in control.

#### J. Wiring and Terminals

Internal wiring shall be of tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end. The terminals shall be embedded in a terminal block of high tracking-resistance compound, or the use of multi pin plug and socket. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The terminal compartment of the actuator shall be provided with a minimum of 3 threaded cable entries.

All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating :

- Serial number



- External voltage values
- Wiring diagram number
- Terminal layout

**K. Enclosure**

Enclosure shall be O-ring sealed, watertight to IP 67 fully protecting the motor and all the other internal electrical elements of the actuator from ingress of water and dust.

**L. Nameplate**

The nameplate shall be manufactured from corrosion resistant material fixed at visible place at the non -removable part of the actuator. Name plate shall give following information as the minimum:

- Manufacturers name
- Serial number and year of manufacture
- Rated ambient temperature
- Rated power
- Rated voltage, phase, frequency
- Rated full load current
- Insulation class
- Rated starting current
- Enclosure class and protection

**M. Painting and Coating**

Painting and coting shall be as per manufacturer's standard finish suitable for environmental conditions in Qatar.

**N. Materials**

Electrical housings and covers:	Aluminium alloy
Gearcase:	Cast iron
Thrust bases:	SG (ductile iron)
Hand wheel:	Steel
Drive bushes and wormwheels:	Aluminium bronze
Worm shafts:	Case hardened steel
Center columns:	Steel heat treated
Oil/gear and thrust bearing lubrications	Manufacturer's Specifications

**4.4.3.3 Inspection and Testing.**



All motor actuators shall be subjected to the following routine tests:

- Measurement of speed and check of direction of rotation.
- Dielectric test.
- Measurement of insulation winding resistance.
- Measurement of winding resistance.
- Hand and pushbutton operations.
- Measurement of acoustic sound level.
- Measurement of vibration.

#### **4.4.3.4 Spare Parts and Special Tools**

The Contractor shall include in his bid, as a minimum, consumables and spare parts for commissioning, and spare parts for guarantee period operation. The Contractor/ Manufacturer shall guarantee, the availability of spare parts for a minimum duration of 10 years.

Contractor shall provide a spare parts schedule that the equipment manufacturers considers should be kept in stock to cover replacements over a period of 2 years.

The spares shall be packed and sealed in individual boxes to preserve the parts against damage and corrosion over long storage periods. Each package shall be clearly identified as to its contents in English.

The Contractor shall provide a schedule of special tools needed for repair and maintenance of the equipment included in his bid.

The spare parts required shall as per Manufacturers' recommendation.

Minimum spare parts required shall be agreed with Kahramaa.

#### **4.4.3.5 Guarantee and Warranty**

The warranty period for actuators shall be two years as defined in General Conditions of Contract. The Contractor shall be responsible for the correction of any defects to the pump sets during the Warranty Period and shall make all necessary repairs and replacements free of charge including labour charges.

### **4.5 CHLORINATION SYSTEM**

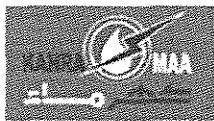
#### **4.5.1 General**

##### **4.5.1.1 Scope of Specification**

This specification covers the minimum requirements for design, manufacture, testing at manufacturer's works, supply, site testing and commissioning of gas chlorination system. This specification shall be read in conjunction with the relevant data sheets, drawings and other relevant sections of the Tender Documents.

This specification document comprises the minimum technical requirements for the Works and Compliance with this specification shall not relieve the Contractor from any of his contractual obligations and responsibilities.

The Contractor shall notify the Engineer of any conflict between this specification, the codes and standards and any other specification included as part of the contract documents applicable.



Deviations and conflicts from this specification shall be listed in details and submitted for review and approval. Any conflicts shall be raised by the Contractor in tender stage and be resolved in writing by Kahramaa or the Engineer.

Any exception of this specification and referenced documentation shall be raised by the Contractor and approved by the Engineer in writing.

#### **4.5.1.2 Abbreviations**

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
BS	British Standard
PWA	Public Works Authority
PRPS	Primary Reservoir & Pumping Station
SRPS	Secondary Reservoir & Pumping Stations
IWPP	Independent Water & Power Producers
LV	Low Voltage
VFD	Variable Frequency Drive
dB	Decibel
GRP	Glass Reinforced Plastic
Cl2	Chlorine
UPS	Uninterrupted Power Supply
PVC	Poly Vinyl Chloride
LED	Light Emitting Diode
QCS	Qatar Construction Specification
°C	Degree Centigrade

#### **4.5.1.3 Operating Conditions**

##### **A. Climatic conditions**

The gas chlorination system and associated ancillaries shall be suitable for operation in the climatic conditions of Qatar.

The Contractor is referred to Appendix A1 Section 1.9 which details the climatic conditions that may be encountered at site. However the offered equipment shall be suitable for the below mentioned conditions as a minimum and the motors shall be de-rated for operation of 52°C.

- Maximum ambient conditions in the shade: 52°C.
- Minimum ambient temperature: 1°C
- Maximum ambient relative humidity: 100%

##### **B. Standards and Codes**

The gas chlorination system shall be designed, manufactured and supplied as per the following specifications, codes and standards. The latest issue of which



available at the time of Contract award shall be used including all amendments, unless noted otherwise.

BS 970 (ISO683) Wrought steel for mechanical and allied engineering purposes

PWA – Chlorine safety Guidelines – Liquefied Gas Chlorine

Qatar Construction Specification QCS 2010 - Section 9 Part 19

#### **4.5.2 Associated Documents**

This Specification shall be read in conjunction with the following documents which, together and in combination, define a complete tender document:

- General Electrical Specification
- General Instrumentation Specification
- General Civil Specification
- Schedule of Technical Particulars
- Schedule of Prices
- Schedule of Drawings.

#### **4.5.3 Design Considerations**

The chlorination system shall be designed in compliance with the above mentioned codes and standards. Alternative (equivalent) standards can be used after written approval by Kahramaa/the Engineer.

The Contractor shall be fully responsible for the strength, adequacy and efficiency of the chlorination system.

The chlorination system shall be a gaseous chlorine dosing system and shall be capable of providing adequate dosing rate at maximum flow conditions.

Gaseous dosing systems shall comprise pressurised and liquefied gas drums or cylinders complete with automatic changeover equipment, gas feeders and solution injection. All gas dosing systems shall be based upon the full vacuum and remote injection principle

The chlorine dosing system shall include drum handling equipment, vacuum regulators, chlorinators, chlorine gas distribution headers, residual controllers, analyser, safety equipment, Chlorine Scrubber Unit and any other piece of equipment to make a complete system.

All materials used in the manufacture of the chlorination system and other equipment within the chlorination building shall be suitable to withstand corrosion action of the chlorine.

##### **4.5.3.1 Chlorine Storage**

The chlorine storage shall be arranged to enable multiple drums to be connected to the liquid chlorine manifold operating as two sets. When the Cl<sub>2</sub> drum pressure falls below 1 bar the auto-change over shall be initiated.



Flexible zinc plated copper (monel) tubing shall be used to connect the drum to the liquid header. An auxiliary valve shall be connected to the drum valve. A mortised valve and pressure gauge switch shall be provided for each drum.

The liquid manifold and all pipework handling liquid chlorine shall be of Schedule 80 seamless carbon steel pipe Grade B ASTM A106. The fitting shall be of forged steel 300 lb. Grade A105

Each half of the liquid header shall incorporate a rupture disc and catch cylinder. The rupture disc shall burst when the pressure exceeds 18 bar and the pressure shall be relieved into the catch cylinder.

Each of the drum support cradles in the service bay shall be fitted with a load cell.

The Contractor shall provide a travelling crane complying with section 4.6 of the specifications for this equipment for the project. The crane shall be designed so as to avoid hoisting of drums over chlorine drums in operation.

#### **4.5.3.2 Chlorinator**

Each chlorinator and controller shall be individually housed in free standing, modular construction cubicles of similar design to provide a neat and pleasing appearance. The chlorinators shall be vacuum operated in conjunction with motive water booster pumps and each shall be complete with remote mounted injector unit and manifold gas inlet, vent and drain lines.

The chlorinators shall be designed as one duty and one standby

They shall be modular design, completely factory assembled in GRP cabinets suitable for installing alongside each other to form a console

Chlorinators shall act on the vacuum principle so that the chlorine is always below atmospheric pressure

They shall be complete with automatic and manual flow rate adjustment, flow meter, positive gas shut off valve, safety pressure/vacuum relief valve, gas inlet pressure regulating valve, remote mounted water operated injector and check valve, inlet pressure and injector suction gauges, vent, drain lines, etc.

The output from each of the chlorinators shall be automatically regulated by an analogue signal from the control equipment specified. Manual adjustment of the chlorine solution flow rate shall also be provided

Chlorinators shall be fitted with vacuum alarm switches to activate remote alarms. These alarms shall be wired through auxiliary contacts on the booster pump starters and also through a timer (0 - 2 minutes) to inhibit the alarm when the chlorinator is shut down or when starting.

The chlorinator vacuum gauge shall be fitted with alarm contacts to initiate an alarm on high or low vacuum.

Water and gas inlet and outlet pipes and cables shall enter from below the cabinets. The chlorinator units shall be arranged for mounting on concrete plinths with suitable ducting and trenching arranged to accommodate the connections.



#### **4.5.3.3    Ejectors**

The ejectors shall be of the aspirator type to give maximum efficiency in mixing the chlorine with the water. The ejector water supply must be designed to suit the maximum rated output of the chlorinators offered.

The ejectors shall be separated from the chlorinators to give flexibility of placing the chlorinators in their rooms and to inject the chlorine solution by the ejectors at the injection point.

#### **4.5.3.4    A    Variable Area Flow Meter (Rotameter)**

Rotameters shall have borosilicate glass metering tube, stainless steel 316 float and wetted Parts to BS 970, scale shall have black markings on white background with a nominal length of 250 mm. Graduation units shall be as specified in the Project Specification. Process connections shall be flanged. Accuracy shall be 2% and 10:1 rangeability. Glass tube shall be easily removable for cleaning.

#### **4.5.3.5    Motive Water Pumps**

The Contractor shall supply and erect electrically driven motive water pumps and boosting pumps. The pumps shall be connected in parallel to supply water to the ejectors.

The pumps shall be multi-stage, stainless steel, ring construction and provided on a duty/standby basis. Pumps shall be provided complete with isolation valves, reflux valves and delivery pressure gauges. Suction and delivery pressure gauges shall be provided on each pump and downstream of flow control valves where flow splitting is provided.

A filter shall be fitted to each suction pipeline.

#### **4.5.3.6    Gas Leak Detection Equipment**

Drum storage area and chlorinator rooms shall be provided with a gas sensing alarm system.

Each store/room shall be provided with sensors mounted in positions to achieve maximum effectiveness with chlorine sensors mounted at a low level. Multiple sensors shall be provided in larger stores/rooms where single sensor may not effectively sense all leaks.

Alarm control panels shall be mounted in a safe area outside the rooms, and shall operate via an integral battery backup system. Where available, the system may be powered from a central uninterruptable power supply (UPS) system.

Alarm control panels shall incorporate the following as minimum requirement for gas leak detection:

- Meter displaying the concentration of the gas leak in mg/l.
- Warning lamps or LED's for each gas sensor to indicate:
- 1st stage leak at 3.0 mg/l
- 2nd stage leak at 10.0 mg/l
- Controls for Ventilation Fans
- Signals for Door Access Warning Lamps



- Signals/ Alarms to Central Control Room or SCADA System
- Signal to Audible/visual warning device.

The automatic Chlorine drum change-over system shall be arranged to change from the duty drum to the standby drum when the 1st stage leak level of 3.0 mg/l is reached. Further drum change-over shall be inhibited until the system is manually reset.

Chlorine drums shall be automatically isolated when the 2nd stage leak level of 10 mg/l is reached and shall continue operating until the gas pressure reduced to zero. Once isolated, drums shall remain isolated until the system is reset and the drum automatic isolation valves manually re-opened. Operation of the automatic isolation system shall initiate a works shut down.

Half the number of ventilation fans in the chlorination room and the chlorine storage area shall be operational under normal working condition i.e. when the chlorine levels are below the 1st stage leak. All the ventilation fans in the affected room shall automatically be switched ON when the 1st stage leak level of 3.0 mg/l is reached. All the ventilation fans in the affected room shall automatically be switched OFF when the chlorine leak level reaches 4 mg/l

When the leak level reaches 4 mg/l the scrubber fans shall then operate to vent out the chlorine gas leak through the chlorine scrubber. The chlorine scrubbers shall be designed to remove the air volume in the affected remove within 120 mins and bring down the levels of chlorine below the 1st stage leak level.

Each access door to stores or rooms shall be provided with warning lamps to permit or prohibit entry. A green lamp shall indicate that it is safe to enter, at leak levels below the 3.0 mg/l threshold: A red lamp shall indicate that a 1st or 2nd stage leak has been detected. Each lamp box colour shall be provided with a minimum of two lamps so that a single lamp failure does not render the indication in-operative.

Each building containing a store or room shall be provided with an external flashing/rotating beacon coloured RED and an audible warning device. The audible device shall produce an output of 106dB(A) at 1 metre and shall remain sounding until such time as the alarm is accepted/cancelled, and it shall cancel by its own after 5minutes. The flashing/rotating beacon shall remain operational whilst 1st or 2nd stage leak persists.

The location of the external flashing/rotating beacon shall be such that it is readily visible to persons entering the site via the main access route.

#### **4.5.3.7 Ventilation**

Drum storage area and chlorinator rooms shall all be provided with forced ventilation systems, design to produce at least 6 volume changes of air per hour, and arranged to provide a negative pressure within the rooms.

Automatic control of the extract fans shall be from the gas leak detection equipment.

Manual control of the fans shall be provided from a safe area outside the rooms. Manual control shall be available regardless of the action of the gas leak detection equipment. The manual control shall be arranged so that it is not possible for ventilation fans to be turned off when the automatic system is calling for the fans to be turned on.

Extract grills and fans shall be positioned at a low level with the fan exhaust arranged to discharge the vented gas away from pedestrian walkways and roadways. If necessary, ducting to a point above building eaves level shall be provided to achieve this, subject to approval by the Engineer.



Intake grills shall be positioned at a high level and arranged so that the entire contents of the room are fully replenished with fresh air when the extract fans are running.

The ventilation fans shall comply with fans specifications covered under Appendix 7.3 MEPF specifications

#### **4.5.3.8 Emergency Breathing Apparatus**

The Contractor shall supply masks with air bottles (cylinders) to allow for working in contaminated air for 30 minutes. Their size shall be according to requirements of personnel dealing with chlorine gas. They shall be stored in a cupboard.

#### **4.5.3.9 Chlorine Scrubber Unit**

The chlorine scrubber unit shall include the following:

- Scrubber Unit.
- Circulating pumping units.
- Air Stack.
- Caustic soda for (2) times use.
- Necessary pipes, fittings, valves.
- Necessary electric connections.

When the concentration of the chlorine gas in the air reaches four (4) mg/lit, by volume, the chlorine leak detectors shall operate the neutralization system.

Caustic soda solution prepared at the bottom part of the neutralization tower shall be sucked by the pumps and delivered to the spraying nozzles at the top of the tower. In the same time contaminated air shall be delivered to the lower part of the tower by the extraction fans. Contact shall happen, between the contaminated air and the caustic soda solution, through the contact rings and the neutralized solution shall be collected back at the bottom of the tank. The process shall continue until the concentration of the chlorine gas in air becomes normal. The neutralized solution shall be drained out from the lower part of the tower and another volume shall be prepared to be ready for emergency cases.

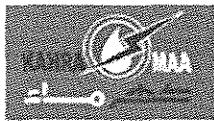
The scrubber unit shall be made from reinforced fibre glass. The neutralizing solution shall be prepared at the bottom of the tower by using of caustic soda ash. In the upper part of the tank, the spraying system with its nozzles shall be installed.

Porcelain or PVC packing rings shall be placed on certain brackets inside the tower for increasing the contact area between the contaminated air and the sprayed neutralization solution.

One duty and one stand-by pump shall be used to circulate, the neutralization solution from the bottom of the tower to the spraying installations.

The pumps shall be of discharge and head to suit the supplied installations.

The pumps shall be manufactured from suitable materials to withstand the corrosion action of the handled media.



## **4.6 LIFTING EQUIPMENT**

### **4.6.1 General**

#### **4.6.1.1 Scope of Specification**

The Works included in this specification consist of the manufacture, witness of inspection by the Engineer's representative at the place of manufacturer, supply, delivery to site, off-loading, storage, protection, on site storage, site transportation, erection, testing, commissioning of all lifting equipment detailed in the following clauses.

This specification document comprises the minimum technical requirements for the Works and Compliance with this specification shall not relieve the Contractor from any of his contractual obligations and responsibilities.

The Contractor shall notify the Engineer of any conflict between this specification, the codes and standards and any other specification included as part of the contract documents applicable.

Deviations and conflicts from this specification shall be listed in details and submitted for review and approval. Any conflicts shall be raised by the Contractor in tender stage and be resolved in writing by Kahramaa or the Engineer.

Any exception of this specification and referenced documentation shall be raised by the Contractor and approved by the Engineer in writing.

#### **4.6.1.2 Abbreviations**

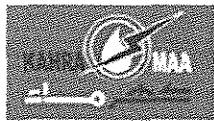
ASME American Society of Mechanical Engineers

BS British Standard

#### **4.6.1.3 Standards and Codes**

The works, equipment and materials shall be designed, manufactured and erected according to the following applicable codes, standards (in their latest edition where not otherwise specified)

ASME B30.9	Synthetic round sling endless
ASME B30.10	Cranes, hooks
BS 466 (ISO 4301, 8306)	Power driven overhead travelling cranes, semi-Goliath and Goliath chain for general use
BS 729 (ISO 1459, 1460, 1461)	Hot dip galvanised coatings on iron and steel articles
BS 449	The use of structural steel in building
BS 466	Power driven overhead travelling cranes.
BS 302 (ISO 2408)	Stranded steel wire ropes
BS 2853	The design and testing of steel overhead runway beams
BS 2902	Higher tensile chain slings
BS 2903	Higher tensile steel hooks
BS 2903	Higher tensile steel hooks for chains, slings, blocks and general Engineering purposes
BS 3032	Higher tensile steel shackles

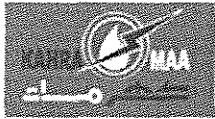


BS 3114	Alloy steel chain, grade 80. Polished short link calibrated load chain for pulley blocks
BS 3243	Hand-operated chain blocks
BS 3243	Specification for hand operated chain blocks
BS 3551	Alloy steel shackles
BS 4942	Short link chain grade (T) 8
BS 4941 (IEC 292)	Specification for motor starters up to and including 1000 V a.c and 1200 V d.c.
BS 5304	Code of practice for safety of machinery
BS 5714	Method of measurement of resistivity of metallic materials
BS 5744	Code of practice for safe use of cranes
BS 6231	PVC-insulated cable for switchgear and control gear wiring
BS 6346	PVC-insulated cables for electricity supply
BS 6405	Non-calibrated short link chain (grade 30) for general engineering purposes
BS 2573 (ISO 4301)	Rules for the design of cranes
BS 6994	Steel shackles
BS 7121	Code of practice for safe use of cranes
BS 7613	Hot rolled quenched and tempered weldable structural steel plates
BS 7668	Weldable structural steels. Hot finished structural hollow sections in weather resistant steels
BS 7671	Requirements for electrical installations
BS 4942 (ISO 1834, 1835, 3075-3077)	Short link chain for building purposes
BS 6994 (ISO 2415)	Steel shackles for lifting purposes
BS EN 287	Approval testing of welders for fusion welding
BS EN 288	Approval of welding procedures for metallic materials
BS EN 1492-1	Flat woven webbing slings
BS EN 10113	Hot-rolled products in weldable fine grain structural steels
BS EN 10155	Structural steels with improved atmospheric corrosion resistance
BS EN 10210	Hot finished structural hollow sections of non-alloy and fine grain steels
BS EN 13414-2	Specification for information for use and maintenance to be provided by the manufacturer
BS EN 13414-1	Slings for general lift services
BS EN 60947	Low voltage switch gear and control gear
ISO 4309/3481 Part 2	Methods of measuring the performance of laboratory electric resistance furnaces.
ISO 2903	ISO metric trapezoidal screw threads tolerances
ISO 7592	Calibrated round steel link lifting chains

#### 4.6.2 Associated Documents

This Specification shall be read in conjunction with the following documents which, together and in combination, define a complete tender document:

- General Electrical Specification
- General Instrumentation Specification
- General Civil Specification
- Schedule of Technical Particulars
- Schedule of Prices
- Schedule of Drawings.



#### **4.6.3 Design Considerations**

The Contractor shall provide the lifting equipment as required to remove equipment for replacement and/or maintenance purposes. The design shall ensure safe access is provided for the operation of the lifting equipment. Overhead cranes may also be required to grant access for maintenance of roof mounted equipment such as light fittings, fans, and shall be designed to facilitate this. Davits shall only be used to lift submersible pump sets and other equipment from wells. Lifting equipment shall be supplied with all the necessary spacers, clamps, harnesses, slings, D links and eye bolts to lift any of the installed plant. Guards shall be provided in accordance with QCS requirements.

Access leader shall be located where appropriate to ensure safe working conditions and easy access to lifting equipment.

##### **4.6.3.1 Design Conditions and Performance Characteristics**

Cranes and lifting equipment shall be suitable for indoor or outdoor installation, as designated.

The high ambient temperature in which lifting equipment and particularly cranes may be required to operate shall be taken into consideration, particularly with respect to the electrical load ratings of motors, switchgear, resistors, cables and wiring, as well as mechanical heat sources such as brakes, bearings and gearing. Due allowance shall be made for possibly higher temperatures than the maximum recorded shade temperature near the roofs of buildings, if the lifting equipment is mounted in a building, or for the effect of direct sunlight if mounted externally.

Design of travelling monorail hoist and bridge crane hoists and incidental accessories shall be based upon the use of a factor of safety of 5, structural beans shall have a factor of safety of 2 with capacity load on all mechanical parts of the system. The factors of safety shall be based upon the ultimate strength of the material used. The equipment shall be of ratings and sizes designated in the Project Specification.

Lifting equipment shall be rated for the load of the heaviest installed item of plant, and designed such that one man can operate it without difficulty.

Hooks and load chains shall reach to the floor of the lowest level.

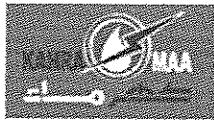
Lifting equipment installations shall comply with BS 5744 and BS 7121.

##### **4.6.3.2 Drawings/Documents**

The Contractor shall provide data and information as described in the following paragraphs.

Design data including the complete structural calculations of crane and monorail member and component sizing and design, shall be submitted, as required by BS 2573, BS 2853 and the building requirements.

Shop Drawings shall be submitted including lay-out drawings which shall clearly show the lifting height of the equipment and clearances in relation to other equipment and structures where the largest items are lifted.



Test certificates shall be submitted as required under factory inspection and testing.

Operation and maintenance manuals and instructions including a copy of the design data, factory and site tests.

#### **4.6.3.3 Monorail Travelling Hoists**

Each hoist shall comprise a manually operated geared travelling pulley block complete with steel runway beams, "A" frame supports where specified and all accessories including slings and spreaders.

Pulley blocks shall be manually operated up to a height of 6 to 8 m. Above 8 m electric hoists shall be provided.

The runway beams shall be designed, tested and certified in accordance with BS 2853.

The blocks shall run on the lower flange of the runway beam and shall be of the spur geared close haul type.

The blocks shall be complete with a geared travelling trolley and shall be capable of being easily removed from the trolley without the necessity for dismantling. The operating chain for the longitudinal motion of the trolley shall extend to within 600 mm of the floor.

Load chain collection boxes shall be provided.

Monorail systems shall not be used for loads exceeding 2000 kg.

#### **4.6.3.4 Cranes**

Cranes shall comprise end carriages and bridge units to be bolted together on site, during erection.

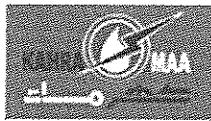
Cranes shall be single girder or double girder as designated.

All exposed moving parts of the drive mechanisms shall be fitted with safety guards wherever possible, in accordance with Part 1.

The bridge girders, end carriages and crab structures of the crane shall be designed and constructed in accordance with all the relevant requirements of BS 466 and BS 2573. With the crane operating under maximum service load, the stress in any operating component shall not exceed the permissible values stipulated in Part 1 of BS 2573. The crane manufacturer shall supply all the information required in Appendix B of BS 466.

The main bridge girders shall be plate or box girder designed as compound beams with the rails for the crab track secured on the top flange.

Jacking points and tie downs shall be provided for both bridge and crab.



#### **4.6.3.5 Manually Operated Chain Blocks**

The hoisting wheel shall be grooved and pocketed to receive the load chain. The load chain shall be stainless steel chain Grade 80 to BS 3114.

Hand chains shall be to Grade 30 BS 6405 or better.

Chain guides shall be provided to ensure effective guidance of the load chain into the load chain wheel pockets. A stripper shall be provided to ensure effective disengagement of the load chain from the load chain wheel.

The idler wheel scores shall be so shaped as to avoid twisting the chain as it passes round. The pitch diameter of the idler wheels shall not be less than 16 times the size of the chain, unless they are so shaped as to avoid a bending action on the link.

The load chain anchorage, associated fittings and framework at the slack end shall be rated at 2.5 times the maximum tension in the load chain when the working load limit is being lifted. Any link used for connecting the load chain to a terminal fitting shall be of the material specified for the chain and heat treated to provide mechanical properties and strength equivalent to those of the load chain.

The hook shall be made from high grade forged stainless steel complying with BS 2903 "C" type and provided with a safety catch. The hook shall be supported on a ball thrust bearing to allow free swivelling under full loads.

The sheaves of the hook block shall be guarded to prevent a hand or fingers being trapped.

The crab hoisting gear shall be such that one man is capable of easily raising the maximum load.

A galvanised mild steel chain collecting box shall be incorporated.

A reliable and effective braking and locking arrangement shall be provided.

Lifting blocks supplied for lifting equipment from wet wells shall be of stainless steel and shall include the facility for obtaining a fresh lift on the equipment lifting chains at 1 metre intervals.

#### **4.6.3.6 Electrically operated Rope Lifting Hoist**

All hoists above a height of 8 m shall be electrically operated.

The hoist rope drum shall be of high quality cast iron with left and right hand spiral grooves to accommodate the hoist rope in one layer. As far as possible, the drive gearing shall be fixed directly to the rope drum to obviate high torsional stress in the drum shaft. The rope shall be securely clamped to the drum.

The hoist drum shall incorporate a wire rope rewind system and guides to prevent the hoist rope skipping and damaging the lay.



The hoist braking system shall be of the automatic electro-mechanical fail safe type which, when the current is cut off or fails will automatically arrest the motion and hold at rest any load up to and including the rated load. The system shall safely control the lowering of the same load from the highest to the lowest point of lift and shall not allow any slippage of the suspended load to occur when the "Raise" motion is initiated.

The hoist rope shall be a flexible wire rope specially designed for usage with cranes and in accordance with BS 302, with a safety factor of not less than six times the maximum tension induced by the safe working load.

The crane hook shall be of high grade forged steel trapezoidal section in accordance with BS 2903, "C" type. The hook shall be supported on a ball thrust bearing to allow free swivelling under full loads and shall also be fitted with a safety catch. The safe working load shall be marked in the hook in accordance with BS 2903.

The sheaves of the hook block shall be guarded to prevent a hand or fingers from being trapped between the sheaves and the in-running rope.

A limit switch shall be fitted to prevent over hoisting. This shall be self-resetting, closing automatically when the hoist motor is put in reverse.

Brakes shall be well protected from oil and grease leakage or spillage, and from adverse effects of atmospheric condensation or dust. A simple and easily accessible means of carrying out adjustment for wear of the shoes or linings shall be provided for all brakes.

Automatic brakes, operating when the drive motor stops shall be supplied for the long and cross travel motions.

#### 4.6.3.7 Mechanical Components

##### A. End Carriage

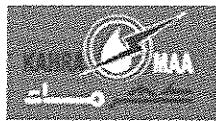
- a) both end carriages of electrically operated cranes shall be powered either by a duplicate geared motor drive, or by a single motor unit and a lay shaft system. Longitudinal and cross traverse motions shall be provided on the crane such that the operation is speedy without impairing safety in working. The longitudinal and traverse motions shall be operated by means of hand chains extending to within 600 mm of the operating floor. The hoisting and lowering chains shall be of the same length.

The hook and load chain shall be such that the hook will reach to the lowest floor level. The operating chain for the longitudinal motion of the crane shall be suitably positioned to enable the operator to move the unit easily, without dragging the operating chains over the control panels or other equipment

- b) the runner wheels shall be of cast steel, with double flanges, mounted on roller bearings, or fitted with phosphor-bronze bushes running on hardened steel axles.

##### B. Crab Unit(s)

- a) the crab frame shall be in accordance with BS 466 and shall provide a strong rigid framework for the hoist and cross-travel machinery mounted thereon.



The placement and layout of mechanical and electrical items shall facilitate easy inspection, service and maintenance of the motors, reduction gearing and braking system

- b) the runner wheels shall be of cast steel with double flanges and mounted on roller bearings. Gearing shall be of totally enclosed type with machine cut gears. Bearings shall be ball or roller.

**C. End stops.**

Resilient or spring type buffers shall be provided on all runway/cross beams and crane rails. Where carriages are equipped with electric travel the end stops shall be provided with limit switches at the end of each direction of travel.

**D. Crane rails.**

These shall comply with BS 449 and BS EN 10155. The line of the rails shall not vary by more than 3mm throughout the whole length of travel. Whenever possible, rails shall be one piece. Where rails are to be jointed this shall be by electrical induction welding.

**E. Access Platforms and Ladders**

- a) safe means of access shall be provided for examination and maintenance of the crane or other equipment only accessible from the crane. Guards shall be fitted where possible under the crab and long travel motor and gearbox assembly to prevent persons on the ground being endangered by falling objects during maintenance
- b) all ladders, platforms and access ways shall comply with QCS Section 8. Open mesh flooring shall not be used. Access ways shall be not less than 800mm wide. The platforms and access ways shall be securely fenced with double tiered guard rails and steel "toe boards" or "kicking plates".

**F. Painting**

This shall be in accordance with QCS Section 8.

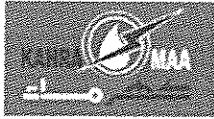
**G. Materials**

Steel used for the fabrication of the lifting equipment shall comply with BS 449, BS 7613, BS 7668, BS EN 10113, BS EN 10155 and BS EN 10210 as applicable. Welding procedures shall comply with BS EN 287 and BS EN 288

**4.6.3.8 Electrical Components**

**A. Motors**

- a) motors shall comply with the Part 1 of this Section and Section 21 except they shall be rated for 150 starts per hour (Duty type S7) for not less than one hour with a shaft output power at least 15% greater than the maximum power which will be required for operation and testing of the crane in the ambient temperature specified, at the maximum rated load.

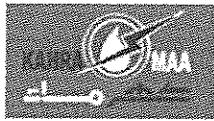


## B. Control Gear

- a) triple pole isolating switch with HRC fuses shall be provided at ground level for each lifting assembly. This switch shall be lockable in the "OFF" position only and shall be provided with a Yale type lock and three keys. The switch shall have a label marked "CRANE ISOLATING SWITCH" in English and Arabic.
- b) the starters and controllers for the crane motors shall be designed and constructed in accordance with the requirements of BS 466, BS 4941, BS EN 60947 and QCS Section 21. All control circuits shall operate at 110 volts
- c) mechanically and electrically interlocked reversing contactors shall be provided for each motion including speed control of the hoist. Accelerating contactors shall cut out
  - the rotor circuit resistance of the motor in steps with suitable delays. Contacts shall be adjustable and renewable
- d) controller and resistors shall be rated such that temperatures do not exceed the limits specified in BS 4941 during operation of the crane under maximum temperature conditions. Starting resistors shall have not less than a "ten minute" rating. Speed control resistors shall be one hour rated
- e) the control gear and cabling shall be suitable for "inching" i.e. many repeated small movements at both creep and normal speed, in any direction of motion
- f) the starters and controllers shall be housed in well-constructed sheet steel panel cabinets of not less than 2mm thick, sprayed and painted with an anti-condensation paint. The enclosures shall be protected against dust and damp to classifications IP 54. Starting resistors shall be mounted in a ventilated section of each control cubicle. The resistors shall all be fitted with terminal bars. The control cubicles shall be provided with lockable hinged access doors, also interlocked with the main isolating switch.

## C. Controls

- a) the long-travel, cross-travel and slow and normal speed hoist motions of each crane shall all be controlled from the lowest level by a pendant push button station. The controls shall operate on a low voltage system supplied by a double wound isolating transformer. Both primary and secondary sides of the transformer shall have HRC fuse protection. One pole of the secondary winding shall be effectively earthed
- b) push button controls shall be of the pendant type with "hold-on" type push buttons automatically returning to the "off" state on release of the button. Push buttons shall be provided for "SLOW -UP", "SLOW DOWN", "NORMAL UP", "NORMAL DOWN", "LEFT", "RIGHT", "FORWARD" and "REVERSE". A larger size red "Emergency Stop" button shall initiate tripping of the control gear main circuit breaker and automatic application of the brakes on all motions. Re-closure of the main circuit breaker shall be initiated by a separate "Reset" button also on the pendant. The pendant shall be oil tight polyethylene,



totally enclosed to IP65, shockproof, and shall be suspended from the crab unit.

The voltage at the pendant shall not exceed 55 volts to earth

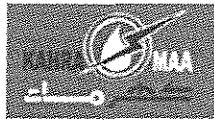
- c) limit switches shall be provided for all motors at the end of each direction of travel
- d) infra-red or radio remote control shall be provided, where specified, or if necessary for safe operation of the crane. Two battery packs with battery charger, sensors, sensor's connecting cables with clips, receiver and decoder shall be provided. Adequate sensors shall be provided at each level (minimum three) to ensure continuous control in all zones of operation. If radio is used then approval shall be obtained by the Contractor for the frequencies used.

#### D. Cables wiring and earthing

- a) an insulated conductor system shall be provided for electrically powered cranes supply. The insulated conducted system shall be of the type where each phase is individually insulated and supported on a metal support. The type where all conductors are contained within a single extruded or moulded insulation will not be permitted. A "festoon" insulated cable system shall be provided for the cross-travel supply
- b) the wiring and earthing of the cranes shall conform to BS 466. Cables and wiring shall be of 600/1,000 volt grade PVC insulated cables in accordance with BS 6231 and BS 6346. Wherever possible, the cables shall be run in screwed heavy gauge galvanised steel conduit. All cable ends shall be clearly labelled with identification of the appropriate terminals
- c) the selection installation and testing of cables and wiring shall be in accordance with BS 7671 except that maximum current ratings shall be raised by a factor of 1.4 times the rating for continuous duty obtained (after applying all necessary de-rating factors for high ambient temperature, grouping and disposition form of installation, etc). The up-rating factor of 1.4 is based on the one hour motors specified for crane operation
- d) the crane structure, tracks, motor frames and metal cases of all electrical equipment, including metal conduit and cable guards, shall be earthed in accordance with BS7671.

#### 4.6.3.9 Factory Inspection and Testing

- (a) The Contractor shall secure from the lifting equipment manufacturer certification that the following inspections and tests have been conducted on each lifting equipment at the factory, and submit to the Engineer prior to shipment.
- (b) Cranes shall be inspected and tested in accordance with the requirements of BS 466 with the difference that the "Tests on Purchaser's Premises" (Clause 54) shall also be carried out in the manufacturer's works and witnessed by the Engineer.



- (c) The works tests shall include overload tests during which a 25% overload shall be lifted by the hoist at the middle of the crane span and sustained under full control whilst it is moved up and down at both normal and creep hoist speeds. Whilst still under overload the crab unit of each crane shall be operated from end to end of its travel.
- (d) The mechanism and controls for the long travel motions shall be tested under light running conditions without moving the crane.
- (e) Tests on manually operated cranes and hoists shall comply with the above insofar as they are applicable.
- (f) Control panels, motor and any factory installed wiring shall be inspected tested in accordance with Part 1 of this Section and Section 21 of QCS.
- (g) motors shall comply with the Part 1 of this Section and Section 21 of QCS except they shall be rated for 150 starts per hour (Duty type S7) for not less than one hour with a shaft output power at least 15% greater than the maximum power which will be required for operation and testing of the crane in the ambient temperature specified, at the maximum rated load.

#### **4.6.3.10 Spare parts and Tools**

Two years supply of spare parts and lubricants shall be supplied for each lifting device supplied.

#### **4.6.3.11 Installation and Commissioning**

##### **A. Installation**

- a) Lifting equipment shall be installed in accordance with the requirements and instructions of the manufacturer. If specified in the Project Specification, the lifting equipment manufacturer shall provide a representative to supervise the installation and testing.

##### **B. Site Tests**

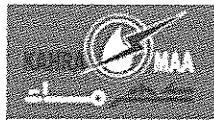
- a) After erection cranes and hoists shall be inspected, tested and certification provided by a qualified independent crane testing specialist in accordance with the requirements of Clause 54 of BS 466 and the tests witnessed by the Engineer. Hand cranes shall be similarly tested.
- b) Electrical equipment shall be tested in accordance with the requirements of QCS Section 21

### **4.7 SURGE PROTECTION SYSTEM**

#### **4.7.1 General**

##### **4.7.1.1 Scope of Specification**

The Works included in this specification consist of the surge and transient analysis study, design, manufacture, witness of inspection by the Engineer's representative at the place of manufacturer, supply, delivery to site, off-loading, storage, protection, on site storage,



site transportation, erection, testing, commissioning of all surge protection equipment detailed in the following clauses.

This specification document comprises the minimum technical requirements for the Works and Compliance with this specification shall not relieve the Contractor from any of his contractual obligations and responsibilities.

The Contractor shall notify the Engineer of any conflict between this specification, the codes and standards and any other specification included as part of the contract documents applicable.

Deviations and conflicts from this specification shall be listed in details and submitted for review and approval. Any conflicts shall be raised by the Contractor in tender stage and be resolved in writing by Kahramaa or the Engineer.

Any exception of this specification and referenced documentation shall be raised by the Contractor and approved by the Engineer in writing.

#### **4.7.1.2 Abbreviations**

ASME	American Society of Mechanical
BS	British Standard

#### **4.7.1.3 Operating Conditions**

##### **A. Medium Characteristics**

The surge protection equipment shall be suitable for handling desalinated potable water with chlorine/Chlorine dioxide content within the parameters of the Kahramaa water quality standards.

##### **B. Environmental Conditions**

The surge protection equipment shall be designed and be suitable for operation in the climatic conditions of state of Qatar (tropical weather, with excess heat dust and humidity at time). Refer to Appendix A1 Section 1.9.

##### **C. Standard and Codes**

The works, equipment and materials shall be designed, manufactured and erected according to the following applicable codes, standards (in their latest edition where not otherwise specified)

ASME Sect. II Part C      Welding Rods, Electrodes and Filter Metals

ASME Sect. V      Non Destructive Examination

ASME Sect. VIII Div. 1      Pressure Vessels  
-- Latest Edition

ASME Sect. IX      Welding and Brazing Qualifications.

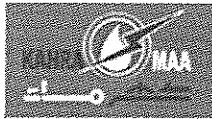


API 5L	Specification for Line Pipe
ASTM A 516	Specification for Plate Material
ASTM A 105	Standard Specification for forgings, Carbon Steel for Piping Components
ASTM A106	Seamless Carbon Steel Pipes for High Temperature
ASTM A234	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperature
ASTM A193	Alloy Steel and Stainless Steel Bolting for High Temperature Service
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.
ANSI/ASME B16.9	Factory Made Wrought Steel Butt Welded Fittings.
ANSI/ASME B16.10	Dimensions and Weights of Seamless and Welded Steel Pipes
BS 449	The use of structural steel in building
BS 729 (ISO 1459, 1460, 1461)	Hot dip galvanized coatings on iron and steel articles
BS 970 (ISO 683)	Wrought steels for mechanical and allied Engineering purposes
BS 1387 (ISO 65)	Screwed and socketed steel tubes and tubulars and for plain end tubes suitable for welding or screwing to BS 21 pipe threads
BS 1571 (ISO 1217)	Testing of positive displacement compressors and exhausters
BS 2872	Copper and alloy stock and forgings
BS 3601 (ISO 2604)	Specification for carbon steel pipes and tubes with specified room temperature properties for pressure purposes
BS 4504 Sect. 3.1	Circular Flanges for Pipes, Valves and Fittings (PN designated). Specification of Steel Flanges
ISO 8501	Preparation of Steel Surfaces before Application of Paints and Related Products
ISO 9000	Quality Management and Quality Assurance Standards – Guidelines for Selection and Use.

#### **4.7.2 Associated Documents**

This Specification shall be read in conjunction with the following documents which, together and in combination, define a complete tender document:

- General Electrical Specification
- General Instrumentation Specification



- General Civil Specification
- Schedule of Technical Particulars
- Schedule of Prices
- Schedule of Drawings.

#### **4.7.3 Design Considerations**

The Contractor shall perform surge & transient analysis study as per QCS 2010 section 9 part 6 to confirm the surge protection equipment design requirements for the complete piping system comprising of piping , reservoirs and pumping station shown on tender drawings as well as other related existing and future pipelines systems connected or to be connected to this contract piping to the approval and satisfaction of the Engineer. The study shall be comprehensive attached with all required recommendations and conclusions, recommending suitable equipment to be installed on piping system to protect from surge effects like surge vessels or anti surge valve or bypass lines etc.

The surge analysis carried out shall include analysis and recommendations for surge protection measures for the system year 2026 under this contract considering the expansion to the ultimate system. The surge protection measures recommended and provided initially shall be capable of simple expansion, or extension to meet the ultimate requirements. The study should take into consideration disturbances in water distribution systems that can be induced by the following situations:

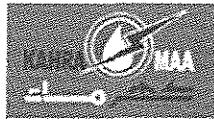
- a) Pump start up or shutdown
- b) Sudden power failure.
- c) Valve opening or closing (variation in flow area)
- d) Changes in transmission conditions

the Contractor shall provide if required, air/water interface type surge vessels, surge tanks, , control valves and other control and surge protection equipment, complete with isolation valves, fittings and accessories, as determined by the Contractor's surge analysis and as per below specifications. Bladder type shall not be accepted.

The supply for the surge vessels shall include an electrically driven rotary screw type air compressor system arranged to automatically charge the vessel with oil free air. The vessels and connecting pipework shall be located with an adequate access for operation and maintenance. Means shall be provided for draining down each vessel and connecting pipework for inspection and maintenance purposes.

The Contractor shall undertake surge analyses to determine the extent of surge pressures or other adverse hydraulic conditions that may occur during the operation of the pumping facilities.

The Contractor shall undertake the following tasks as an integral part of the surge analysis for each system:



- a) Update a mathematical model provided by the consultant based on selected equipment or modification to the pumping system including pumps and pipeline profile if any.
- b) List the steady state condition under which the system will operate.
- c) List, with reasons, the most adverse surge conditions under which the system will operate.
- d) Determine maximum and minimum surge pressures along the system that can occur due to system operation.
- e) Identify possible surge suppression options listing their advantages and disadvantages for the system analysed.
- f) Recommend the preferred option giving details of the maximum and minimum pressures to which the system will be subjected with the surge suppression equipment installed. Full details of the surge suppression equipment and ancillary equipment shall be given.
- g) Prepare a Surge Analysis Report providing full details of tasks (a) to (f), including sufficient data sheets, figures and analysis output, etc. from the network fluid flow simulation software to allow the Engineer to undertake a detailed review of the Surge Analysis Report.

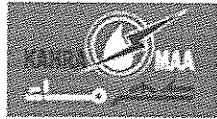
As a result of the Engineer's review, where revisions to the Surge Analysis Report are instructed by the Engineer, the Contractor shall incorporate these into the report and reissue the report at no additional cost to Kahramaa.

The format of the Surge Analysis Report shall be agreed with the Engineer after tasks (b) and (c) have been completed and before analyses are commenced. A summary of the findings from tasks (b) and (c) shall be presented with the proposed report format.

#### **4.7.3.1 Design Conditions and Performance Characteristics**

The surge vessel system shall be designed and sized to the following:

- maximum design conditions for pumps and piping
- worst flow supply scenario
- Positive (over) pressure - Positive surge pressures shall not exceed the design pressure of the pipeline
- Minimum (under) pressure - Minimum surge pressures shall be maintained at +1m
- Contamination during negative pressure cases and leakage during excessive pressures.
- Recommendation from piping manufacturers.
- Water supply system stoppage during maintenance of piping period.



- Pump cavitation and piping lining damage

The Contractor shall assume no inertia assistance from any air valves fitted.

#### **4.7.3.2 Drawings**

Upon approval of surge analysis study, detail design drawings for the suggested surge protection equipment along with all necessary ancillaries like piping, compressor room, fire protection, fire alarm A/C, etc. all to specifications shall be submitted for Kahramaa review and approval.

#### **4.7.3.3 Surge Protection System Components**

Upon approval of surge study results, the proposed surge protection system shall comprise to but not limited to following:

- 1) Surge vessels with compressors

Surge vessel details:

The surge vessels shall be installed horizontally, compressor air type, with capacity as per approved surge analysis report equipped with all necessary flanged nozzles, access ladder, operational platform etc., manufactured and tested to BS 5500, ASME section 8 division1 or to latest standards from welded steel internally hard vulcanized rubber lined (minimum thickness of 3 mm) or 325 micron epoxy internal coating and 325 micron epoxy external coating with certificates from all international authorities.

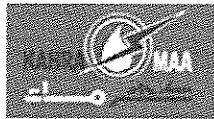
The vessel shall be installed over concrete foundation and the room below the surge vessel is to be provided with drain piping to nearest available drainage system.

The selected materials for surge vessel components shall be as per follows:

- (i) Mild steel pressure parts BS 1501-151-288A.
- (ii) (Mild steel non-pressure parts –BS 4360.
- (iii) Mild steel forgings – BS 1503

Requirements for connections and fittings, etc., include:

- Saddle supports for horizontal mounting, or legs for vertical mounting, complete with holding down bolts.
- The vessel shall be equipped with minimum of flanged nozzles for following services:
  1. Safety pressure relief valve nozzle rated for not less than 150 % working
  2. Water supply and discharge nozzle
  3. Access inspection manhole of suitable size
  4. Drain nozzle



5. Two level switch manifold
6. Two level indicators. Calibrated level sight glass of the reflective type covering the full range of water level in the vessel and having top and bottom shut off cocks, hinged safety shutter and pressure/level calibrations carried on a substantial engraved plate.
7. Two air inlet nozzle
8. Pressure gauge nozzle
9. Level transmitter
10. Solenoid air vent valve with isolation valve.
11. Lifting lugs
12. Access ladder and platform,
13. Lifting lugs provided to enable handling of the vessel on site without damage to the painted surfaces

The surge vessel shall be provided with level switches for high level, low level, alarms, and level indicators.

The level of water shall be maintained on normal level, in case water level goes up due to increase of distillate Line pressure, the compressor shall start to pressurize space above water to push water level back to normal level.

In case water level goes down to low level, the relief valve installed on surge will open releasing some air, when pressure above water decreases, the water level will go up.

Compressor operation shall be controlled also by pressure switch installed on air receiver where compressor is supposed to start at low pressure and stop at high pressure.

The air pressure above water level in surge vessel has to be set and maintained based on specified parameters during commissioning stage.

The isolating valve installed on the line supplying the surge vessel shall be kept open and shall be protected from any accidental operation all the time and to be interlocked with forwarding pumps operation.

All instruments are to be interconnected with allowing them to be monitored and controlled fully.

A local control panel with all necessary control including on/off switches, alarms, etc. is to be installed in the air conditioned space of compressor room.

The surge vessels system shall be provided with two screw type compressors units (one running and one standby) arranged to charge vessels with compressed air automatically.

The compressors shall be oil-free air cooled, single or multi fitted with automatic unloading valves.



Cylinder heads shall be readily removable for inspection. Each cylinder shall be constructed to provide easy replacement and maximum cooling.

#### **4.7.3.4 Compressors**

The compressor units assembly shall comprise of the following:

1. Two Electric motor driven rotary screw type air compressors and motors complete with air filter, after cooler, air intake silencer, water separator, pressure regulator and any other necessary accessories where all are to be installed on the same skid. Compressors shall be tested in accordance with BS 1571.

The compressors maximum pressure and capacity, air receiver minimum pressure and capacity shall be all sized based on results of surge analysis report and each unit capacity shall be able to supply all required amount of air to the surge vessels

2. cylindrical air receiver vessel to BS 5500 of suitable capacity and made of hot dip galvanized steel complete with pressure gauge, water separator, condensate drain, alarm, control pressure switch for automatic control of compressor, safety relieve valves etc.. The air receiver volume shall be at least six times the total volume of the air compressed in 1 minute, at duty pressure.
3. Air supply lines installed all the way from air receiver and up to surge vessels shall be of the galvanized heavy gauge steel tubing type, to BS 1387. All isolating valves, safety and non - return valves filters, bends, tees, unions and other fittings shall be of galvanized steel to BS 143 and shall be of the correct size and type for the steel tubing in use. Screwed or flanged joints may be incorporated. Pipes shall be flanged to BS 4504, PN 16 where required to make connections with plant items, and shall be designed for a pressure of not less than 3 x relief valve pressure blow point. Air main velocity shall not exceed 6 m/s.

Pipework shall be installed horizontally and vertically but shall fall in the direction of air flow to facilitate draining of condensate. Automatic drains shall be fitted to prevent the accumulation of condensate at low points in the system. the nominal fall of the pipework shall be 1-in-80.

Pressure relief valves and condensate drain valves shall be provided as required by the operating system. Isolating valves shall be full bore diaphragm or ball pattern.

4. Control panel equipped with all necessary monitoring and control instruments for compressors

#### **4.7.3.5 Compressor Room**

All above equipment of compressors, air receiver, and control panel are to be installed inside the compressor room which shall be single room suitable to accommodate above equipment.

The room shall have small partition air conditioned space to accommodate the control panel of compressors.



The room shall be provided with ventilation system comprising of extracting fans, louvers, sand trap as indicated to allow for efficient cooling of compressors.

The room construction shall include all necessary windows, doors, lighting and shall have fire protection system.

#### **4.7.3.6 Factory Inspection and Testing**

Design and manufacture of the vessel shall be subject to approval by an independent Inspection Authority to carry out the necessary certification and testing at each stage of manufacture to verify that the vessel meets all the requirement of above standards. On satisfactory completion of the vessel, the supplier shall provide an Inspection Certificate, endorsed by the Inspection Authority.

The factory tests shall comprise but not limited to followings:

1. Hydrostatic test to vessel one and half times the working pressure for period not less than half hour.
2. Adhesion test
3. High voltage test for rubber lining
4. Coating thickness by electronic devise
5. Visual inspection

Certificates required as per the code shall be a minimum of the following:

- Welding procedures.
- Physical & chemical properties, heat treatment, non - destructive tests

#### **4.7.3.7 Spare Parts and Tools**

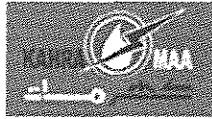
The Contractor should include all necessary and required spare parts for surge protection equipment operation and provide relating special of standard tools and accessories.

Spare parts shall suitably be packed and labelled as to the related apparatus for long storage under the climate conditions prevailing in Qatar.

The spare parts should be sufficient for five years operation of surge equipment and the Contractor should provide the complete list of spare parts and relating unit prices.

All tools shall be of high quality and housed in a suitable, portable, and lockable metal box.

The Contractor shall provide from the specialist manufacturers of the surge equipment all the spares and tools required during the commissioning periods as specified. Special tools, if required for normal operation/or maintenance of any component of the surge control system, shall be supplied with the equipment.



## **4.8 STEEL PIPEWORK**

### **4.8.1 General**

#### **4.8.1.1 Scope of Works**

The Works included in this specification consist of the manufacture, witness of inspection by the Engineer's representative at the place of manufacturer, supply, delivery to site, off-loading, storage, protection, on site storage, site transportation, erection, testing, commissioning of carbon steel piping materials from DN 80mm (3" NB) and above up to DN 2400 mm (80").

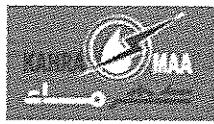
This specification document comprises the minimum technical requirements for the Works and Compliance with this specification shall not relieve the Contractor from any of his contractual obligations and responsibilities. The Contractor shall notify the Engineer of any conflict between this specification, the codes and standards and any other specification included as part of the contract documents applicable. Deviations and conflicts from this specification shall be listed in details and submitted for review and approval. Any conflicts shall be raised by the Contractor in tender stage and be resolved in writing by the Owner or the Engineer. Any exception of this specification and referenced documentation shall be raised by the Contractor and approved by the Engineer in writing.

#### **4.8.1.2 Abbreviations**

ASME	American Society of Mechanical Engineers
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
EN	European Standard
BS	British Standard
NPS	Nominal Pipe Size
UNC	Unified Coarse
ERW	Electro Resistance Welding
PFI	Fabrication Institute
SASO	Saudi Arabian Standard Organization
IIW	International Institute of Welding

#### **4.8.1.3 Standards and Codes**

- ASME B31.3 Process Piping.
- ASME B16.9 Factory made, Wrought Steel Butt Welded Fittings.
- ASME B 36.10 Dimensions and Weights of Seamless and Welded Steel Pipes.
- ASME B.1.1 Unified Inch Screw Threads.
- BS 4504 Sect 3.1 Circular Flanges for Pipes, Valves and Fittings (PN Designated). Specification for Steel Flanges
- BS EN ISO 1461 Hot Dip Galvanizing.



- BS 6956 Rubber Gaskets
- ASTM A105/A105M Standard Specification for forgings, Carbon Steel for Piping Components.
- ASTM A106 Seamless Carbon Steel Pipe for High Temperature Service.
- ASTM A193 Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service.
- ASTM A 194 Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.
- API 5L Specification for Line Pipe.
- ISO 7005 Part 1 Steel Flanges
- ISO 10474 Steel and Steel Products – Inspection Documents.
- EN 10204: Metallic Products – Types of Inspection Documents
- BS 970 Part 1 General inspection and testing procedures and specific requirements for carbon, carbon manganese alloy and stainless steel
- ISO 9000 Quality Management and Quality Assurance Standards – Guidelines for Selection and Use.
- ISO 8501-1 Preparation of steel substrates before application of paints and related products – surface roughness.

#### **4.8.2 Associated Documents**

This Specification shall be read in conjunction with the following documents which, together and in combination, define a complete tender document:

- Schedule of Technical Particulars
- Schedule of Prices
- Schedule of Drawings.

#### **4.8.3 Design Considerations**

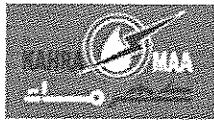
The Contractor shall provide the carbon steel piping for sizes above 1600mm diameter for the main pipe lines, for all the sizes within the main pumping hall and for the other systems specified in the tender documents.

##### **4.8.3.1 General**

The wall thickness of piping components shall be determined by the Design Engineer considering the applicable design conditions, accordance with ASME B 31.3 code, considering 3 mm corrosion allowance. The piping shall be capable of withstanding satisfactorily all resultant forces exerted by normal pressures and any surge pressures which may arise from sudden reversal of flow during starting up or shutting down of any portions of the system. Material grades, wall thickness, branch connections, etc. shall be as per applicable drawings.

##### **4.8.3.2 Pipes**

Pipes shall conform to API 5L Grade B, unless specifically mentioned otherwise. Pipe manufactured to ASTM A 106 Grade B shall be considered an acceptable substitute for API 5L Gr B. Pipes shall be seamless up to and including size DN 400 mm. Above DN 400 mm, they shall be Electrically Resistance Welded (ERW), unless specified otherwise.



All pipe sizes are designated as nominal pipe sizes (NPS) only. The following range of nominal pipe sizes shall be used. Outside diameter of pipe shall meet the requirements of ASME B 36.10 or API 5L as applicable.

#### **NOMINAL PIPE SIZE**

<b>METRIC (mm)</b>	<b>Equivalent to</b>	<b>INCH</b>
DN 80		3
DN 100		4
DN 150		6
DN 200		8
DN 250		10
DN 300		12
DN 350		14
DN 400		16
DN 450		18
DN 500		20
DN 600		24
DN 900		36
ND 1000		40
DN 1200		48
DN 1400		56
DN 1600		64
DN 1800		72
DN 2000		80
DN 2200		88
DN 2400		96

Schedule of Pipe thickness for the Carbon Steel Pipes:

DN 300 to DN 1000 - 9.525 mm

DN 1200 = 11.125 mm

DN 1600 = 15.875 mm

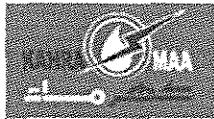
DN 2200 = 20.625 mm

DN 2400 = 23.56 mm

#### **4.8.3.3 Fittings**

Fittings shall be to ASME B16.9 for sizes 24" and below. Fittings for size 24" and below shall be seamless. Elbows with butt welded ends shall be long radius type (radius equals 1.5 times the nominal pipe size). Short radius elbows shall not be used. If mitre elbows are economically justified in accordance with the ASME B31.3 requirements, they may be substituted for bends or wrought fittings as follows: -

- Three weld (90 degree) and two weld (45 degree) mitre elbows may be used in sizes larger than 24 inches. The nominal radius of the mitre elbow shall not be less than 1½ times the diameter of the pipes.



- Bends may be substituted for welded elbows provided they are made of seamless pipe. Cold bends shall be limited to 6" size or smaller, subject to satisfying code requirements.

Elbowlets shall not be used for branch connections, instrument taps or vent and drain connections unless space considerations dictate. Drain and vent connections shall not be installed in elbows. Thermo wells installed at other than 90 degrees to the pipe header or vessel wall are not allowed.

Reducing tees and reducers shall be supplied with butt weld end schedules to match the pipe, the allowable size combinations are as shown in ASME B16.9. Branch connections shall be made from equal tees or reducing tees, integral reinforced branch fittings as approved by Kahramaa/Engineer. In case reducing tee of required combinations is not available a combination of reducing tee and reducer shall be used.

#### **4.8.3.4 Flanges**

Flange dimensions shall be conforming to BS 4504 Sect 3.1 / ISO 7005 Part 1 and the rating of the flanges shall be as per the applicable data sheet. All the flanges shall be welding neck raised face type. Slip on raised face flanges shall be accepted in place of welding neck flanges to suit the project requirements and as approved by Kahramaa/Engineer.

For the gasket contact surface of DN 600 (24") and smaller flanges, the surface roughness shall be made between Ra 6.3 and 12.5 µm. For nominal sizes above DN 600 (24"), the surface roughness shall be between Ra 12.5 and 25 µm. Serrations may be either spiral or concentric.

#### **4.8.3.5 Gaskets and Bolting**

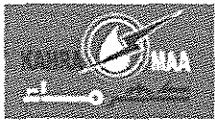
Material of gaskets shall be EPDM rubber, having 3mm thickness, suiting flange dimensions of the applicable standards. The gasket shall extend from the inside diameter of the flange to at least the inside edge of the bolt holes or may laid beyond the bolt circle to the outside diameter of the flange.

Bolts and nuts shall be alloy steel conforming to ASTM A 193 Gr B7/A 194 Gr 2H and have regular square and hexagonal dimensions. Bolts and nuts shall be galvanized or cadmium plated and supplied with necessary washers.

The galvanizing shall conform to hot dip galvanizing as per BS 729 code to give a minimum average coating of 305 g/m<sup>2</sup> and a zinc thickness of not less than 43 microns.

Screw threads shall be UNC for 1 inch and smaller bolt diameters and 8-UN for larger diameters, Class 2 fit, in accordance with ASME B1.1.

Machine bolts shall only be used for jackscrews. Jackscrews shall be threaded full length. The length shall be measured from the bearing surface of the head and shall include the end point.



#### **4.8.4 Internal and External Coating**

##### **4.8.4.1 Internal Coating**

Internal surface of the pipes and fittings shall be blast cleaned to SA 2.5 in accordance with ISO 8501-01/SIS 05 59 00 standards and coated to a total dry film thickness of 500 microns as detailed below.

Fusion bonded epoxy coating compliant with AWWA C213 for the Interior and Exterior Steel Water Pipelines

##### **4.8.4.2 External Coating**

External surface of the pipes and fittings shall be blast cleaned to SA 2.5 in accordance with ISO 8501-01/SIS 05 59 00 standards and epoxy coated/painted to a total dry film thickness of 500 microns as detailed below.

Under the ground – Fusion Bonded Epoxy, with factory applied Polyethylene sleeve.  
Within the pumping station - External coating shall be Liquid epoxy coated

The Joints to be coated in liquid epoxy after welding and heat shrink wrapped.

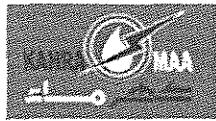
#### **4.8.5 Cathodic protection requirement**

CP (ICCP - Impressed current Cathodic Protection or SACP - Sacrificial anodes cathodic protection) system shall be provided for buried section of the pipe lines mainly suction line from the reservoir to the pumping station, inlet ring mains, overflow lines from the reservoir and the pumping main. The Contractor shall submit the Cathodic protection layout, design calculations report, detailed drawings for Cathodic protection at joints.

For the road crossing; the CP shall be provided to metallic pipeline along with standard test stations/reference electrodes for potential monitoring.

The deliverables shall consist of the following, but not limited to the following:

1. Power source generally AC power TR unit which provides DC current for the ICCP system.
2. Buried anodes (in case of short lengths of pipelines) - MMO deep well ground bed, OR MMO canister anodes OR MMO wire anodes buried in the same trench as the pipeline.
3. Junction boxes (Anode Junction box for terminating the positive cables), (Negative junction box to terminate the negative cable from pipelines), Bond boxes shall be provided for the carbon steel pipes running in the same corridor as shown in the layout drawings.
4. Standard test stations along each carbon steel pipeline to measure the potential along with ref electrodes.



#### **4.8.6 Inspection and Testing**

##### **4.8.6.1 Shop Inspection / Testing**

Inspection and testing of all pipes, fittings and flanges shall be in accordance with applicable API, ASME, ASTM, ANSI, ISO, BS specification. All material test certificates shall indicate conformity to the requirements.

The Kahramaa/Engineer reserves the right to stage-inspect the materials, manufacturing process, testing, etc. Such inspection does not relieve the Vendor of the responsibility of suitable design and workmanship.

Contractor shall submit a detailed Inspection and Test Plan (ITP) or Quality Control Plan (QCP) for approval showing manufacturing, inspection and testing activities, its acceptance criteria prior to commencement of manufacturing. All Certification shall be 3.1.B as per ISO 10474. The radiography test and hydro test shall be witnessed by Kahramaa/Engineer.

The Contractor/Manufacturer shall make suitable provisions for testing and inform Kahramaa/Engineer sufficiently (at least one month) in advance to enable their representatives to witness the test. If witnessing of any tests is not satisfactory and a retest is required, the cost of the witnessed retest shall be borne by the Contractor.

Manufacturer shall ensure that all the applicable codes and standards available at their works for Kahramaa/Engineer's reference during their visit to manufacturer's works for shop inspection/test.

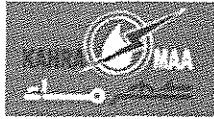
The test and material certificates for all the items shall be entered in the manufacturing data/project record books. These shall include the witnessed tests and the documents shall be submitted to Kahramaa/Engineer prior to the despatch of the materials.

#### **4.8.7 Packing and Shipment**

Pipes shall be provided with adequate cushioned support during all stages of handling, transport and storage in order to prevent damage to the pipe, its wrapping or lining. Steel pipes with concrete lining shall not be moved by rolling. If stacked in tiers, each pipe of the bottom tier shall be supported on at least two purpose made cradles each giving continuous 120° support and cushioned with bags of sand, sawdust or other approved material. Each pipe of the upper tier and of any intermediate tier shall be similarly cushioned at all points of contact. The pipe manufacturer's recommendations as to stacking shall be strictly observed.

The period between completion of the external protection of a pipe and the completion of its installation shall be kept to a minimum and this period shall not generally exceed six months.

Each pipe and fittings shall be indelibly marked over any factory applied coating with the diameter, nominal pipe thickness, class, grade of steel, length of pipe and works test pressure and shall in addition carry a unique reference number to enable items to be correlated to works fabrication records, works test certificates, delivery notes and the like. It shall be marked with wall thickness and steel grade. Wherever possible, the marks shall be painted on the outside of pipes and fittings close to one end.



Where there is insufficient smooth surface area to accommodate the above information the marking shall be put on rust proofed metal tags secured to the item with galvanized wire.

The flanges of pipes and fittings shall be protected by wooden discs attached by means of service bolts or by other approved means. These bolts shall not be used in the actual job.

#### **4.8.7.1 Design Code**

ASME B31.4 is defined to be the prevailing standard for liquid transportation systems. For special applications and parts not covered by the above mentioned code, the AWWA Manual M11 shall be used.

#### **4.8.7.2 Drawings/Documents**

The Contractor shall furnish following vendor data as a minimum along with the bid:

- Detailed reference list to fulfill criteria for acceptance.
- Catalogues/Brochures.
- Cross section drawings with detailed parts list, as applicable.
- Detailed material specifications.
- Completely filled-in and stamped data sheet.
- Dimensioned general arrangement drawing, as applicable.
- Complete details of testing facilities at manufacturer's works.
- Local (Qatar) agent name and address.

Bids not accompanied by all of above-mentioned information shall be considered incomplete and liable to be rejected.

### **4.9 SITE ELECTRIC VEHICLES**

#### **4.9.1 General**

##### **4.9.1.1 Scope of Specification**

The Works included in this specification consist of the design, manufacture and witness inspection by the Engineer's representative at the place of the concerned manufacturers works, supply, delivery to site, off-loading, storage, protection, on site storage, site transportation, testing, commissioning of all the equipment detailed in the following clauses for the electric vehicles, all in accordance with the Specification.

The works shall include all works, ancillaries and accessories necessary for the performance and operational requirements herein specified. There shall be included all



items, components, connections and services to make the equipment complete and perfect in every part and detail and operational as a complete item.

This specification document comprises the minimum technical requirements for the Works and compliance with this specification shall not relieve the Contractor from any of his contractual obligations and responsibilities.

Deviations and conflicts from this specification shall be listed in details and submitted for review and approval. Any conflicts shall be raised by the Contractor in tender stage and be resolved in writing by Kahramaa or the Engineer.

Any exception of this specification and referenced documentation shall be raised by the Contractor and approved by the Engineer in writing.

#### **4.9.1.2 Abbreviations**

kph	Kilometres per hour
hp	Horsepower

#### **4.9.1.3 Environmental Operating Conditions**

The vehicles and associated equipment shall be designed and be suitable for operation in the climatic conditions of state of Qatar (tropical weather, with excess heat dust and humidity at time). Refer to Appendix A1 section 1.9.

The vehicles will be kept and operated outdoors, within the boundaries of the PRPS site.

### **4.9.2 Design and Construction Requirements**

#### **4.9.2.1 Service life**

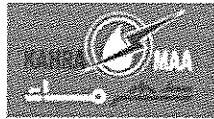
The vehicles covered by this specification shall be suitable for the specified operation conditions and shall be designed and manufactured for a minimum service of 20 years.

Low maintenance cost, reliability and trouble free operation shall be a prime consideration when selecting the bid pumps.

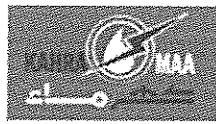
#### **4.9.2.2 Specified requirements**

The vehicles shall comply with the following requirements:-

- a) Power Source: Electric Drive
- b) Motor: 48-volt high efficiency shunt wound motor with internal solid state tachometer/sepex
- c) Drive Unit: 12.3:1 direct-drive axle, double-reduction helical gear
- d) Horsepower: 3.7 hp @ 3,400 rpm (continuous)
- e) Electrical System: 48-volt
- f) Charger: Automatic, computer-controlled 48-volt DC, 17 amp, UL and CUL listed



- g) Batteries: Eight 6-volt, Heavy Duty: T145 = 145 min @ 75 amps
- h) Controller: 500A solid state
- i) Front Suspension: fully independent leaf spring with dual hydraulic shocks
- j) Rear Suspension: leaf springs with dual hydraulic shocks
- k) Steering: self-adjusting rack and pinion, permanently lubricated with sealed bearings
- l) Frame Chassis: rust proof aluminium I-beam or welded steel frame protected with a multi-step full-immersion phosphate treatment, electro-deposition epoxy-based coating, and an electrostatic applied polyester/urethane powder
- m) Body (front and rear): thermoplastic olefin, painted with a two-part topcoat of high-lustre automotive grade polyurethane
- n) Body (intermediate) fibre-reinforced plastic
- o) Bumpers: front and rear 8 kph energy-absorbing bumpers
- p) Brakes: maintenance free 4-wheel mechanical drum
- q) Park Brake: foot-operated, multi-lock
- r) Seating: seamless, fabric-backed vinyl bonded to pure, warp and moisture resistant polypropylene bottom, strengthened with plated steel inserts
- s) Speed Range: 8 to 25 kph
- t) Maximum reverse speed: 8 kph
- u) Front Tires: 18 x 8.50-8, 6-ply rated
- v) Rear Tires: 18 x 8.50-8, 6-ply rated
- w) Seating capacity: 6 persons (passenger vehicles), 2 persons (maintenance vehicles)
- x) Instrumentation: Battery capacity indicator, Battery warning light, Halogen Headlights, and Horn
- y) Minimum ground clearance: 110 mm
- z) Additional Features. Vehicles shall additionally have the following as part of the standard vehicle:
  - Roof Shade
  - Cargo Box where required
  - Front Windscreen
  - Rear View Mirrors
  - Front Windscreen Wipers / Washers
  - Mud Flaps
  - Reverse Warning repeater
  - Hazard warning triangles
  - No Smoking Stickers
  - Fire Extinguisher Min 1.5 Kg Type ABC
  - Spare Tyre
  - Tool Kit for road repairs and spare wheel removal
  - GCC Conformity
  - Communication display module
  - Glove box with lock



- Hour meter
- Turn Signals
- Security Patrolling light. (Ser. No 2)
- Air Conditioning

aa) All vehicles shall originate from USA, Europe or Japan.

#### **4.9.3 Deliverables**

The Contractor shall submit the following technical deliverables prior to commencement of production, for Kahramaa/the Engineer approval, comprising but not limited to minimum of the following:

- Vehicles and charging system: Technical Datasheets.
- Drawings showing the dimensions and details of all components
- Material specification of all components
- Certificates confirming the suitability of materials
- List of recommended spare parts.
- Details of any special tools required.
- Compliance to specification statement
- Operating instructions and preventative/corrective maintenance manual, illustrated spare parts list, instructions and schedule for checking and maintenance, troubleshooting guide in English and Arabic
- Quality control, inspection and test plan

#### **4.9.4 Spare Parts and Special Tools**

The Contractor shall provide a spare parts schedule that the equipment manufacturers considers should be kept in stock to cover replacements over a period of 2 years.

The spares shall be packed and sealed in individual boxes to preserve the parts against damage and corrosion over long storage periods. Each package shall be clearly identified as to its contents in English.

The Contractor shall provide a schedule of special tools needed for repair and maintenance of the equipment included in his bid.

Minimum spare parts required shall be agreed with Client.

#### **4.9.5 Guarantee and Warranty**

The warranty period for the vehicles shall be two years as defined in General Conditions of Contract. The Contractor shall be responsible for the correction of any defects during the Warranty Period and shall make all necessary repairs and replacements free of charge including labour charges.



**4.10 Not used.**

**4.11 FIRE FIGHTING SYSTEM (EXTERNAL)**

**4.11.1 General**

**4.11.1.1 Scope of Specification**

This Specification provides the requirements for design, manufacture, testing & supply of the fire protection equipment and accessories. The specification details out the minimum requirement for such items as the hydrant assembly, pressure relief valves, breeching inlet, flow meter and air release valves to be used for the fire water system.

Design of the fire water system equipment shall generally comply with the following:

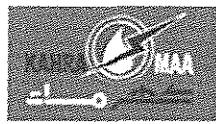
Fire Water System : NFPA 24 (Standard for Private Fire Mains)

The Contractor shall include all equipment and services required to provide a fully complete and functional installation.

This specification document comprises the minimum technical requirements for the Works and compliance with this specification shall not relieve the Contractor from any of his contractual obligations and responsibilities. The Contractor shall notify the Engineer of any conflict between this specification, the codes and standards and any other specification included as part of the contract documents applicable. Deviations and conflicts from this specification shall be listed in details and submitted for review and approval. Any conflicts shall be raised by the Contractor at Tender stage and be resolved in writing by Kahramaa or the Engineer. Any exception of this specification and referenced documentation shall be raised by the Contractor and approved by the Engineer in writing.

**4.11.1.2 Abbreviations**

API	American Petroleum Institute
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
NFPA	National Fire Protection Association
UL	Underwriter's Laboratories
FM	Factory Mutual



#### **4.11.1.3 Standards and Codes**

The works, equipment and materials shall be designed, manufactured and erected according to the following applicable codes, standards (in their latest edition where not otherwise specified)

- Qatar Construction Specification (QCS 2010)
- Qatar General Electricity & Water Corporation: Standards, Specifications and Regulations
- ASTM A193/ M Standard Specification for Alloy-Steel and Stainless Steel A193- Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
- ASME B 16.5 Steel Pipe Flanges and Flanged Fittings
- ASME B 16.9 Factory made wrought steel Butt Welding Fittings
- ASME B 16.21 Non Metallic Gaskets for Pipe Fittings
- ASME B1.1 Unified Inch Screw Threads
- ASME B16.20 Metallic Gaskets for Pipe Flanges
- ASME B1 20.1 Pipe Threads General purpose
- ASME B16.11 Socket Welded and Screwed Fittings
- NFPA 20 National Fire Protection Association standard for the Installation of Centrifugal Fire Pumps
- NFPA 15 National Fire Protection Association standard for private Fire hydrants

#### **4.11.2 Associated Documents**

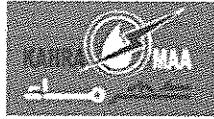
This Specification shall be read in conjunction with the following documents which, together and in combination, define a complete tender document:

- General Electrical Specification
- General Instrumentation Specification
- General Civil Specification
- Schedule of Technical Particulars
- Schedule of Prices
- Schedule of Drawings.

#### **4.11.3 Equipment Specifications**

##### **4.11.3.1 Fire Hydrants**

Refer to Section 9 of the General Specification of Main Laying Materials for Waterworks (Appendix A10).



#### **4.11.3.2 Pressure Relief valves**

##### **A. Design and Construction**

Pressure Relief valve (PRV) shall be provided in the Diesel Pump Discharge side to relieve any excess pressure in the system. The PRV shall be of hydraulically operated, pilot controlled, diaphragm type, Globe/Angle type. The PRV shall maintain a constant system pressure regardless of the demand fluctuations. The valve shall be pilot controlled and should not be affected by back pressure of the fire water system. The PRV shall have a design pressure at least 200 psi. The inlet and outlet of the valve shall be flanged to ANSI B 16.1 Class 150.

The Pressure Relief valve shall have the following material of construction :

Body	-	Ductile Iron to ASTM A 536-65-45-12
Trim	-	Bronze/ Stainless Steel
Pilot Control System	-	Cast Bronze with SS trim

The pilot control shall be direct acting, adjustable spring loaded diaphragm type valve designed for modulating service to permit flow when the controlling pressure exceeds the spring setting.

Size of valve shall be according to the pump size and recommendations of NFPA 20 (2007 edition), Table 5.25 (a). The valve shall be coated with fusion bonded epoxy to RAL 3000 (Red).

##### **B. Operation of the Valve**

The activation of the PRV shall be by fire water line pressure through pilot control system and should open fast in order to maintain steady stream pressure in the system. The closure of the valve shall be gradual to control surges and shall re-seat drip tight within its 5% of its pressure setting.

The pressure relief setting of the PRV shall be field adjustable in the range of 100 to 300 psi.

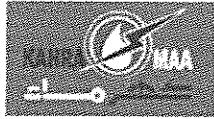
##### **C. Testing**

The valves shall be individually pressure tested at following hydraulic pressure:

- Body – 24bar
- Seat – 17.6bar

A factory test certificate shall be issued for each valve giving its serial number in order to be submitted with the valves, if requested by the concerned Engineer.

The Contractor shall obtain the necessary installation drawings from the manufacturer and shall store, transport, handle and install the valves and appurtenances in strict accord with the manufacturer's drawings and recommendations. Care shall be taken during mounting of logs to avoid warping the frames and to maintain clearance between seating faces.



#### **4.11.3.3 Flow meter**

Flow meter shall be installed on the Fire Pump Discharge side to measure the flow of the fire pumps. The size of the flow meter shall be as per NFPA 20 requirements based on the fire pump size.

The flow meter shall be Venturi type with a flow range of up to 175% of the rated measuring flow capacity. The meters shall be of Aluminium with 4" dial, 1/4"MNPT connections SS 304 case with rubber ring and glass window with buna-n seal. Control ball valves shall be brass to CA 360 and hoses shall be rubber with a working pressure of 750 psi.

#### **4.11.3.4 4-Way Breeching Inlet**

##### **A. Design & Construction**

Breeching inlet shall be 4-way type with inlet of 150 NB flange and in compliance to BS 5041 part-3. Each of the 4 landing outlets shall be of 65 NB size with female instantaneous couplings to BS 336 standard. The outlet of the breeching inlet shall be a 150 NB flanged connection to ANSI B 16.1 class 150.

Each valve shall be provided with a cap and chain arrangement. The working pressure shall be 200 psi with a test pressure of at least 300 psi.

The Breeching Inlet unit shall be supplied complete with an Electro-galvanized steel metallic cabinet epoxy painted (red) suitable for recess mounting. The size of the cabinet shall be suitable for the breeching inlet.

The body of the valves shall be as Ductile Iron to A536/ Spheroidal graphite iron and with Internals to SS/Bronze/ Gun Metal.

The breeching inlet valve shall be epoxy coated externally. The chain of the blank cap shall be chrome.

The body of the breeching inlet shall have a drain valve and each inlet coupling shall have its own integral spring loaded check valve.

##### **B. Operation of Valve**

The Breeching Inlet shall be operated manually and the hose connection to the landing valves shall be quick instantaneous type.

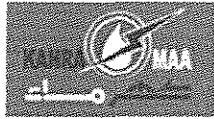
##### **C. Testing**

The valves shall be individually pressure tested at following hydraulic pressure:

- Body – 20bar
- Seat – 17.6bar

A factory test certificate shall be issued for each valve giving its serial number in order to be submitted with the valves, if requested by the concerned Engineer.

The Contractor shall obtain the necessary installation drawings from the manufacturer and shall store, transport, handle and install the valves and appurtenances in strict



accord with the manufacturer's drawings and recommendations. Care shall be taken during mounting of logs to avoid warping the frames and to maintain clearance between seating faces.

#### **4.11.3.5 Air Release Valves**

Air release valves shall be provided at the highest point of the pump discharge piping inside the pump house. The size shall be 1 inch and shall have a working pressure of 200 psi with min. 350 hydrostatic test pressure.

The valve shall be single orifice type construction with plastic float. The body and bonnet shall be Ductile Iron to 500-7 AS 1831. All fasteners in the valve shall be Stainless steel type. The valve shall be able to release air under pressure and shall not shut prematurely.

The air release valve shall have inlet screwed type with an isolation valve on the upstream for maintenance purposes. The ARV shall be UL/FM approved.

#### **4.11.4 Inspection and Tests**

The Manufacturer shall perform all Inspection and Tests as per the requirements of this Specification and the relevant Codes at his Works prior to shipment. The cost of such Inspection and Tests shall be included in the Tendered Sum and shall comprise of, but not be limited to, the following:

##### **4.11.4.1 Visual Inspection**

Dimensional check on all valves shall be carried out as per Kahramaa / the Engineer's approved drawings.

Chemical composition and mechanical properties, including hardness, shall be checked as per relevant material standards and this specification, for each heat of steel used.

- a) Non-Destructive examination of individual valve material and components consisting, of but not limited to, castings, forgings and assembly welds, shall be carried out by the manufacturer.
- b) Body castings of the valves shall be radio graphically examined on 100% of the surface of critical areas as per ASME B 16.34. Procedures and acceptance criteria shall be as per ASME B 16.34. All castings shall be subject to wet magnetic particle inspection on 100% of the internal surfaces. Method and acceptance shall comply with MSS-SP-53.
- c) All valves, with forged bodies shall be ultrasonically examined, in critical areas, in accordance with the procedure and acceptance standard of Attachment - E of ASME B 16.34. All forgings shall be subject to wet magnetic particle inspection on 100% of their forged surfaces. Method and acceptance shall comply with MSS-SP-53.

All finished wrought weld ends, subject to welding in the field, shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the end. Laminations shall not be acceptable.

Weld ends of all cast valves, subject to welding in the field, shall be 100% radio graphically examined and acceptance criteria shall be as per ANSI B 16.34.



All valves shall be hydrostatically tested in compliance with the requirements of relevant AWWA/NFPA/BS standards.

Kahramaa/Engineer also reserves the right to witness tests as indicated above at the Manufacturer's works, prior to the shipment. The Manufacturer shall give reasonable access and facilities required for inspection to Kahramaa's/Engineer's inspector. The Kahramaa/Engineer reserves the right to require additional testing, at any time, to confirm or further investigate, a suspected fault. The cost incurred shall be to the manufacturer's account. In no case shall any action of Kahramaa/Engineer, or their Inspector, relieve the manufacturer of his responsibility for material, design, quality or operation of the valves. Inspection and tests performed/witnessed by Kahramaa's/Engineer's Inspector shall in no way relieve the manufacturer of his obligation to perform the required inspection and tests.

Kahramaa/ The Engineer may, at their discretion appoint a third party inspection agency to carry out inspection on behalf of, or together with, Kahramaa's/Engineer's inspector.

#### **4.11.5 Test Certificates**

Manufacturer shall submit the following certificates in accordance with EN 10204 3.1:

- a) Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the equipment construction as per the relevant standards.
- b) Test certificates for hydrostatic and pneumatic tests complete with duration and pressure records of each test.
- c) Test reports of radiography, ultrasonic, MPI and DP inspection.
- d) All other test reports and certificates as required by this Specification.

The certificates shall be valid only when signed by the Kahramaa's / Engineer's Inspector. Only those Valves which have been certified by the Kahramaa's/Engineer's Inspector shall be dispatched from the Manufacturer's works.

The Manufacturer's Serial No. and the Tag No. of the Valve shall provide a cross reference to all Documentation required in accordance with EN 10204.

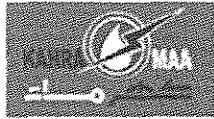
The Manufacturer's Serial No. and the Tag No. of the Valve shall provide a cross reference to all Documentation required in accordance with EN 10204.

#### **4.12 FIRE PUMPS**

##### **4.12.1 General**

The system shall be such that in case any demand is required, the jockey pump should start due to pressure drop in the system through pressure switch. In case the water demand exceeds the supply capacity of jockey pump the Electric pump should start through the pressure switch to meet the water demand. In the event of power failure the diesel engine should start through a pressure switch provided for it. The diesel pump should have both facilities to stop automatically arid manually,

The pumps shall be fitted with mechanical seals, pressure switches that will individually start the pumps. The main and stand-by pump shall be connected to a remote alarm panel. Each pump shall be fitted with automatic air release valve. Discharge pressure gauge + valve, and suction compound pressure/vacuum gauge + valve. The pump sets shall be manufactured, assembled, tested and supplied by an approved Manufacturer.



Fire Pump Set shall be of Horizontal Split—Case Pump Centrifugal type in accordance with NFPA 20 and ANSI requirements, capable of delivering the scheduled duties. The appropriate flow rate for engine and pump cooling shall be added to the net duties given.

#### **4.12.2 Equipment Specification**

Pumps shall be listed for fire protection use and chosen on the basis of water supply available. The electrically driven fire pumps shall be connected to a reliable power source.

Supplier shall provide and install a complete fire pump set, which shall serve the water spray system.

The fire pump shall be fully automatic package unit consisting of Electric Motor driven pump to act as duty pump, and Diesel Engine driven pump to act as standby pump and Electric motor driven Jockey pump.

The scope of work include supply, shop testing, commissioning of the fire Pump Set. All the equipment's shall be suitable in all respects for the local climatic conditions.

The pump shall be capable to deliver 150 % of the rated flow capacity at not less than 65% of the rated head, in conformance to NFPA 20. (Standard for the Installation of Centrifugal Fire Pumps)

The Fire Pump Room shall be provided with Split Air Conditioner.

Drain pipes shall be provided at delivery head of the electric/ diesel pumps with drain valves (Gate valve with plug.) to maintain the minimum required flow of the pump at closed head to avoid overheating.

Diesel Engine toolkit is to be provided with a padlock and shall be mounted in the fire pump room.

Contractor shall provide monorail (electrically operated) of suitable capacity inside the pump room. The monorail shall be extended up to the door entrance for easy movement and handling of equipment. Monorail shall be provided inside the Fire Pump House.

All pressure gauges inside the pump room to be provided with anti-vibration fluid.

Fire Pumps pressure sensing line shall be installed separately for the Electric, Diesel & Jockey pumps with 2 nos. of Non- return valves (orifice type) with a distance of 1.5m apart and all materials shall be stainless steel grade SS 316 L or higher. Pressure sensing line shall be laid at elevated level along with the other piping works inside the pump room and shall not be laid at the floor level.

Power cables from the fire pump room DB (located inside the Fire Pump room) to the fire pump controllers and from controllers to Motors shall be armoured type.

The size of the fire pump room shall be sufficient enough to accommodate the Fire Pumps, Controllers, Piping, Valves, instruments, etc. Care shall be taken to ensure that all fire pumps i.e. Electric Pump set, Diesel Pump set shall be installed to ensure easy maintenance.



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Pressure relief valve with waste cone arrangement shall be provided for the Diesel Pump and the relief line discharge routed to the fire water tank.

Manufacturer's recommendation shall be considered for pump house sizing.

All electrical equipment inside the pump room shall be suitable for a 50oC ambient temperature.

Battery filler is to be provided inside the fire pump room required for the maintenance of the diesel engine batteries & shall be mounted/ fixed at suitable location nearby to the Diesel Engine battery set.

Waterproof padlock & GI chains with master key shall be provided for all fire protection valves in the system or supervisory gate valves shall be provided for the same.

Permanent filling arrangement for the diesel fuel tank shall be provided and this arrangement shall be provided from outside of the Fire Pump Room.

The base frames of both electric and diesel pumps shall be supported by G.I. shims of suitable size.

Grouting shall be provided for the complete gap inside in-between the pump foundation and base frame.

Air release valve shall be provided at the topmost location inside the Fire Pump Room.

Greasing shall be provided for all the FPS valves & also PVC conduit cover shall be provided with end capped & chain for all the spindles of gate valves.

The vent arrangement (flame arrestor) for the Diesel Fuel Tank shall be extended outside of the Fire pump room.

The rated capacity (i.e. on name plate) of the Fire Pumps shall not be less than the calculated 100% duty fire water demand. Selection of the rated capacity of the Pump to operate along the Pump curve at more than 100% duty is not acceptable. The rated capacity shall be rounder off to the nearest higher UL/FM rated capacities. Fire Pumps capacity (rated) shall be based strictly on the hydraulic calculations only. It must be noted that the selected Pump performance curve must satisfy the 150% flow (with 65% head) along the performance curve as per the requirements of Kahramaa based on NFPA 20.

The above requirements must be demonstrated during FAT and this shall be verified at site during Fire Pumps Performance/Flow testing.

The HP Rating selection (of both motor & engine) shall be selected considering 150% of duty flow conditions. It shall be noted that utilization of 1.15 service factor to achieve the actual HP required during pump operation @ 150% flow is not acceptable.

As per NFPA 20 requirements, all pressure gauges provided shall be at least twice the rated pressure of that of the pump.

Power supply arrangement (SLD) for the Fire pump Controllers shall be submitted for Kahramaa review & approval. A DB shall be provided inside the Fire Pump Room with separate isolators for the jockey pump controllers and diesel pump controller. However,



the supply for the Main Fire Pump Electrical Controller will be directly connected to one of the feeder in the Main LV Switchboard without any isolators/switches in between.

Capacity of the Jockey Pumps shall be not less than 3-4% as that of the main pumps. 2 Jockey Pumps shall be provided with the capacity split into 2 equal halves (2x50%) and the design shall be such that both jockey pumps operate on an alternate cycle basis to reduce the wear and tear of the jockey pumps. Please note that splitting of Jockey Pumps into 2 equal halves is very important considering the redundancy & safe operation of Fire Fighting Pumping Station.

**Fire Pump – Controllers** shall be provided with dry run protection & also option shall be provided inside the Controllers for automatic shutdown of pumps if the Kahramaa decides to incorporate this during Commissioning or later on.

All fittings provided inside the Fire Pump Room shall be of welded type only.

V-type aluminium ladders of (2mts & 3mts) height shall be supplied & kept inside the Fire pump room or store and shall be provided with padlock.

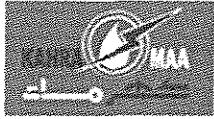
Piping inside the Fire Pump Room shall be designed and arranged in such a way as to allow free movement of personal inside the Fire Pump Room without any obstructions or limitations whatsoever. It will remain the specialist responsibility to ensure that the design complies with Kahramaa requirement. As far as possible, it should be noted that suction and test return line piping are placed on top of each other so as to ensure that space is saved inside the Fire Pump Room. Discharge piping outside the Fire Pump Room shall be routed through trench from the inside of the Fire Pump Room itself.

#### **4.12.3 Construction**

The pump casing shall be of extra heavy cast iron, with minimum tensile strength of 30,000 lbs. and shall be split parallel to the shaft. Bearing housing supports, suction and discharge flanges shall be cast, bored and machined integrally with the lower half casing. Upper and lower half casings shall be dowelled and bolted together. Removable upper half casing must permit inspection or removal of the entire rotating assembly without disturbing the piping. Flanges shall be No.125 ASA flat Face Suction and No.250 ASA Flat Face Discharge.

The impeller shall be of Bronze enclosed single opposed suction type both statically and hydraulically balanced. The impeller shall be keyed to a steel (416 Stainless steel) shaft. The shaft shall be protected by; (416 Stainless steel) (ceramic coated 416 stainless steel) (316 steel) sleeves with a gasket joint between it and the impeller for protection against shaft corrosion. The sleeves will be positive drive by means of a key and with an external shaft sleeve nut set screwed to the shaft for a reduction in shaft wear.

The pump shall be equipped with Bronze renewable throat bushings, casing rings, and inter stage channel ring to reduce casing wear and maintenance costs. The casing rings and channel ring shall be held by Anti-rotational pins to permit easy reinstallation and reduce down Time, impeller wear rings are optional and will be of Bronze material. The rotating element shall be mounted in (Grease) (Oil) lubricated ball bearings (when temperatures rise above 2250F. Water jackets shall be added). Heavy cast split glands shall be furnished on each stuffing box design for easy removal for packing inspection and maintenance. Various mechanical seals can also be installed, Heavy fabricated steel base (with drip lip) to mount the pump and driver shall be furnished. Flexible shaft



coupling shall be furnished to connect the driver pump. Coupling shall be enclosed in (standard) coupling guard.

#### **4.12.4 Motor**

The main pump set shall be provided with a direct drive totally enclosed 2900 rpm Standard Motor wound for a 415 volt 3 phase 50 Hz. supply with class "F" insulation complete with flexible coupling and mounted with motor alignment jacking points.

Motors to be NEMA Design B squirrel cage induction type (drip—proof) with (1.15) with (1.0) service factor and suitable for operation on (230/415volt, 3Phase, 50hz. power supply). Motor size shall be sufficient to prevent overloading at operating conditions or at the lowest listed head conditions whichever point requires greater horsepower. Following installation, grouting and connection of all piping pump and motor must be checked for alignment in accordance with standards of the ill.

The stand-by pump shall be driven by a diesel engine of the four-stroke compression-ignition mechanical injection type. It shall be directly connected to the pump shaft via flexible couplings and mounted on a galvanized and painted steel base complete with the starting batteries and fuel tank of sufficient capacity for 6 hours running at full load. Cooling of the engine shall be via the pumped firewater, which will pass through a water heat exchanger to drain. The engine shall be manufactured by a reputed international firm specialized in this field and be complete with all exhaust piping, insulation and be complete with all exhaust piping, insulation and silencers.

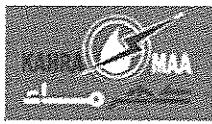
#### **4.12.5 Diesel Engine**

The engine shall be water cooled type and shall be according to BS 5306 and incorporating components such as twin drive belts, fire resistant fuel pipes, close governor control (4.5% drop) and 13.5, guarding. The diesel engine fuel tank shall have a capacity equal to 1 Gallon/Horse power + 5 % Volume for Expansion + 5% volume for sump. According to the power output of the engine, the electrical system shall have either 12V DC or 24V DC. The Diesel engine shall have the following facilities:

- Oil pressure switch shall be for low oil pressure indication, alarm or stop engine through control.
- Engine temperature switch for high engine temperature indication, alarm or stop the engine through control.
- Fuel solenoid (electrically operated) in order to stop the engine with a switch or control.
- Stopping lever to stop engine by pulling this lever manually.
- Starter motor and solenoid are powerful starter motor and solenoid relay, which are fitted on the engine.
- Alternator for charger battery, tachometer, indicators, etc.
- Air releasing pumps to release the air from fuel line to engine.

The diesel engine shall be provided with the following:

- Lubricating System
- Exhaust System.
- Cooling System
- Fuel System
- Pump Circulating System



Diesel Engine Cooling water piping & fuel pipe shall be of stainless steel grade 316 L or higher.

Each pump with its engine or motor shall be assembled and tested as a packaged-unit complete with its own starter panel, etc.

#### **4.12.6 Jockey Pumps**

The jockey pump shall be capable of performing the duty as specified in Section 4.12.2. Each pump shall be of the high efficiency vertical multi-stage type direct driven by a 2900 rpm totally enclosed electric motor with class "F" insulation and wound for a 415 volts 3 phase 50 Hz. Power supply.

#### **4.12.7 Fire Pump Set Controller**

Each pump set shall have its own individual control panel complying with requirements of the relevant N.F.P.A. 20 requirements, with each having a pressure switch connected to the fire main header via a 15 mm diameter tube.

All pressure switch pipe works shall be arranged with a test valve and an upstream drain valve assembly. The Diesel and Electric Pumps shall also be fitted with a back flow bypass and non - return valve to allow either or both pumps to operate even if the test valve is inadvertently left isolated.

The enclosures shall be mild steel and powder coated red panels. Control switches, Indicators and motors shall be fitted on the doors of the controller.

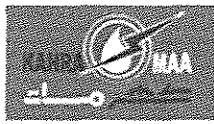
#### **4.12.8 Main Pump Controller:**

Enclosure degree of protection shall be IP 56 or equivalent NEMA 4/4X Enclosures. The main pump controller shall have the following facilities:

- Door interlocked isolator switch,
- Fuses
- Contactors for star delta starting
- Overload relay to protect the motor for overloading.
- Control relays.
- SFT fuses for control.
- Indicators for power on, pump run, trip etc.
- A meter to show the motor running current
- Selector switch for hand off auto mode etc
- Anti-condensation heater
- Neutral Link
- Break Glass Manual Start push button and stop push button (if required).
- Phase Sequence, loss monitoring & alarm
- Pressure sensing Transducer
- Automatic start sequence
- Electronic display control panel with all features including digital display, normal power source annunciation, pressure setting field adjustment etc.

#### **4.12.9 Standby Pump Controller:**

Enclosure degree of protection shall be IP 56 or equivalent NEMA 4/4X Enclosures.



The standby pump controller shall have the following facilities:

- A charger in order to keep the battery always charged a meter shall be provided to show the charging status.
- The charger ON/OFF switch shall be provided on the panel door and Voltmeter shall be fitted on the door to show the battery status.
- Timer for starting pulse: With this timer, cranking is adjusted to the required time.
- Timer for off delay: It helps to avoid immediate ON and OFF of the engine.
- Control Fuses.
- Control Relays.
- Indicators for DC healthy, pump run, pump trip fail to start etc.
- Emergency push button shall provide on the door to stop the engine in emergency condition.
- Hand off auto selector switch
- Relays for low oil pressure engine temperature.
- Tachometer
- Hour run meter
- Break glass manual start switch.
- Audible warning device
- Individual Battery charger – 24 V
- Starting of the engine by push button switch
- Automatic starting of the engine at set pressure
- Individual battery circuit breakers
- Electronic display & control panel
- Automatic shutdown at engine over speed with alarm
- Automatic shutdown at Fire water Tank low level

The batteries shall consist of two groups, one of which shall be operational & the other standby.

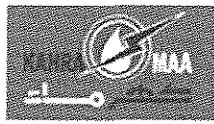
#### **4.12.10 Jockey Pump Controller:**

Enclosure degree of protection shall be IP 56 or equivalent NEMA 4/4X Enclosures.

The Jockey Pump Controller shall have the following Facilities:

- Minimum run period timer (0.5 to 5 minutes)
- Loss of Power Alarm relay
- Door interlocked isolator switch.
- Starter (Star delta for above 4.0 KW motors) for Jockey Pump Motor
- Overload protection.
- Control fuses,
- Indicators for run, trip, power on
- Hand off auto selector switch etc
- Terminals are provided in all panels for easy cable termination.

All of the pumps shall run either manually (by turning the selector switch to hand mode) or automatically. In auto mode, the pumps will run automatically due to pressure fall discharge line and stop automatically when the pressure reaches the set point. Pressure switches shall be provided on the discharge manifold at the required points for this function.



An hour-run-counter is to be provided for the Jockey Pump to monitor the amount of leakage in the system.

#### **4.12.11 Ancillary Equipment**

The installation shall be complete with all necessary valves, pressure gauges, alarms, proving and testing equipment etc., as required by the NFPA —20 rules.

The pump set shall be equipped with:

- A pressure Relief Valve which shall be UL/FM approved. The valve opens quickly to relieve excess pressure in the system and maintains a constant pressure in the fire pump discharge, regardless of flow rate throughout the system. It should contain pilot system to maintain a fixed relief pressure with high accuracy and dependability, eliminating the typical leakage and dependability, eliminating the typical leakage and jamming problems found in mechanical, spring loaded relief valves.
- Flow Meter Unit shall be provided on the discharge line in order to check the capacity of the pump set. This unit shall have the following components and specifications.

Propeller shall be magnetically coupled with the drive mechanism through the sealed oil filled gearbox to eliminate water entering the meter assembly. The propeller shall be conical shaped three bladed propellers.

Bearing in propeller shall be water lubricated ceramic sleeve and spindle bearing system with a ceramic/stainless steel spindle.

Indicator - Totalizer shall be mechanically driven by the meter mechanism and features a ful14 diameter, 250 degree sweep dial with a six digit, straight reading type total size and sweep test hand.

Change gears shall be easily exchanged in the field when changing the dial or when re calibrating for different pipe sizes

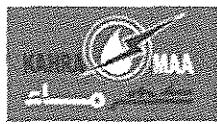
#### **4.12.12 Indication Panel**

The Contractor shall provide a dedicated indication panel for the complete installation, which shall have the following facilities;

- Schematic diagram showing locations of all major items of plant, i.e. pumps, control valves, section valves, electric alarm pressure switches, etc. Each item shall be clearly engraved in Arabic and English.

Each main pump shall have the following indications:

- Amber Lamp for fault alarm,
- Red Lamp for fire alarm.
- Green Lamp for correct system status



The Jockey pump shall have the following indications:

- Green Lamp for pump running.
- Amber Lamp for fault alarm.

Each control and sectional valve shall have the following indications:

- Green lamp for valve open
- Amber Lamp for fault alarm, valve

Each electric alarm pressure switch shall have the following indications

- Amber Lamp for fault alarm.
- Red Lamp for fire alarm.

#### **4.12.13 Water Supplies**

##### **A. Storage**

Water storage facilities shall be provided to suit the given hazard rating which shall be calculated on the maximum water flow and time at this flow rate as indicated by NFPA20 regulations.

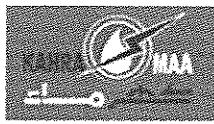
The design of the Fire Water tank shall comply with NFPA22 requirements. The capacity of Fire Water Storage Tanks is to be decided as per the requirement based on detailed calculations.

Contractor must ensure the positive head at the firewater pump suction all the times. The effective capacity of the tank shall be the volume of water between the 'centreline of suction outlet' (for pump suction) and the inlet of the overflow.

The fire water tank furniture & ancillaries shall include the following: -

- Internal ladder which shall be stainless steel and shall be constructed so as not to be directly affected by water pressure on to the Tanks' walls and bottom
- Tank external ladder or stairways shall be provided for access to manhole and inspection of float valve chambers.
- High-level float switch & Low-level float switch
- Float valve (Ball type valve)
- Fire pumps - test return line nozzle (flanged)
- Water Content dial gauge
- Fire pumps suction line nozzle (flanged)
- 65mm drain outlet connection (flanged end gate valve)
- Air vents with bird/insect screen
- Float Valve inspection chamber with hinge type cover including lock & key arrangement.
- Manhole access chamber with hinge type cover including lock and key arrangement.

All metallic wetted parts in direct contact with water shall be stainless steel of grade 316L or higher for the fire water tanks.



All (internal & external) bolts, nuts & washers shall be of stainless steel type SS 316 L or higher.

**B. Supply Pipe work:**

Pipe work to the Fire water tank shall ensure that the Fire water tank is re-filled within 8 hours as per the NFPA 22 requirements.

Below ground, pipe work shall be Ductile Iron or UPVC, Class E, above ground Schedule 40; galvanized pipe work shall be used. All fittings & valves shall be of brass or G.I. The termination points for this contract shall be:

**C. Fire Water Tanks - Compartmentalisation:**

Fire water tank is provided with two separate compartments with the total water volume equally distributed between both tanks for all the fire water requirements for the site. Also, please note that The total water volume shall be considered from the top of the pump casing. Segregation of the Fire water tanks into 2 numbers is to ensure that there is total redundancy in the system considering the future maintenance requirements and also to avoid the total isolation of the complete Fire Fighting system in case of any leakages in the Fire water tank.

**4.12.14 Approval**

Upon completion of the systems, the specialist contractor and contractor shall furnish the Kahramaa a certificate of approval from legally constituted authorities having jurisdiction, or in lieu thereof, a certified copy of the same.

**4.12.15 Operating Instructions**

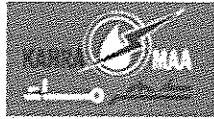
Upon completion and approval of the systems, the contractor shall provide an experienced Engineer to instruct the Kahramaa's operators in all details of operating and maintaining the system. The specialist sub-contractor shall provide three (3) sets of type written operation instructions, parts list and service manuals for all equipment, wiring diagrams, control diagrams and test reports suitably bound.

Drain valves, test valves, control valves, shall be fitted with approved enamelled signs indicating their use.

Operating Instructions for maintenance of Jockey pumps, electric pump & diesel pump shall be provided and this shall be laminated and fixed on the wall near all the fire pump controllers.

**4.12.16 Record Drawings and Manuals**

The contractor shall hand over prior to the completion of the works the record drawings and manuals in accordance with contract specifications and requirements and for the approvals from KM & QCDD.



#### 4.13 Valves for Fire Fighting System

##### 4.13.1 Standards and Codes

ASTM A193/A193-M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASME B 16.1	Cast Iron Pipe Flanges and Flanged Fittings
ASME B 16.5	Steel Pipe Flanges and Flanged Fittings
ASME B 16.9	Factory made wrought steel Butt Welding Fittings
ASME B 16.25	Specification for Butt Welding Ends
ASME B36.10	Welded and Seamless Wrought Steel Pipe
ASME B 16.21	Non Metallic Gaskets for Pipe Fittings
ASME B1.1	Unified Inch Screw Threads
ASME B16.20	Metallic Gaskets for Pipe Flanges
ASME B1 20.1	Pipe Threads General purpose
ASME B16.11	Socket Welded and Screwed Fittings
AWWA C 504	Standard for Butterfly Valves
AWWA C 509	Standard for Resilient Seated Gate valves

##### 4.13.2 Equipment Specification

###### 4.13.2.1 Gate Valves (65 NB & Above)

###### A. Design & Construction

Valves shall conform to the latest version of AWWA Standard C-509 covering Resilient Seated gate Valves for Water Supply Service.

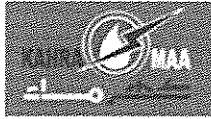
The valves shall have the following material of construction:

Body	-	Cast Iron to ASTM A126 Cl.B
Stem	-	Bronze to ASTM B16/ B806
Cover	-	Cast Iron to ASTM A126 Cl.B
O-Ring	-	Buna-N
Hand wheel	-	Cast Iron to ASTM A126 Cl.B

The wedge shall be totally encapsulated with rubber. The sealing rubber shall be permanently bonded to the wedge to meet ASTM tests for rubber metal bond ATSM D249.

All gate valves of 65NB & higher shall be outside yoke and screw type OS&Y (rising stems) type. All stems shall operate with bronze stem nuts.

The body, bonnet and stuffing plate shall be coated with fusion bonded epoxy, both interior and exterior. Epoxy shall be applied in accordance with AWWA C550 or equal.



All internal parts shall be accessible without removing the body from the line. Valves shall be supplied with O-Ring seals at all joints. All stem O-Rings shall be replaceable with valve fully opened and subjected to full pressure.

Gaskets for the flanges shall be non-metallic EPDM full face type. Flat gaskets are not acceptable.

Flanges of the flanged end valves shall be integral with the body of the valve. Face to face/end to end dimensions shall conform to ASME B16.10.

Flanged Ends shall have dimensions as per ASME B16.1. Flange face shall be raised face (RF) with smooth finish to 3.2 to 6.3 micro-meter Ra as per ASME B 46.

Waterway shall be smooth, unobstructed and free of all pockets, cavities and depressions in the seat area. Valves shall accept a full size tapping cutter.

The opening of the valves shall be by turning and shall be provided with a hand wheel with the mark "Open" and an arrow cast in the metal to indicate the direction to open.

#### B. Operation of Valve

All valves shall be manually operated by means of hand wheel. The diameter of the hand wheel shall be such that under the maximum differential pressure, the torque required to operate the valve does not exceed 350 Nm. The valve shall incorporate a micrometer calibration head.

Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.

When specified in the Data sheets, the Valves shall have locking devices to lock the Valve either in the fully open (LO), or fully closed (LC), position.

#### C. Testing

All valves shall be individually pressure tested at following hydraulic pressure:

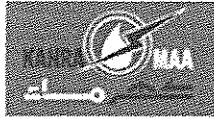
- Body – 24bar
- Seat – 17.6bar
- Disc – 24bar

A factory test certificate shall be issued for each gate valve giving its serial number in order to be submitted with the valves, if requested by the concerned Engineer.

The Contractor shall obtain the necessary installation drawings from the manufacturer and shall store, transport, handle and install the valves and appurtenances in strict accord with the manufacturer's drawings and recommendations. Care shall be taken during mounting of gates and logs to avoid warping the frames and to maintain clearance between seating faces.

#### 4.13.2.2 Gate Valves – Threaded (15 NB to 50 NB)

Gate Valves of sizes up to 50 NB shall be provided for drains and jockey pump suction & discharge piping as applicable in the fire water main. The valves shall have be OS & Y rising stem type with Solid wedge disc and Teflon packing.



These valves shall have the following material of construction:

Body	-	Bronze to ASTM B16
Bonnet	-	Bronze to ASTM B16
Stem	-	Silicon Bronze to ASTM B371 Alloy C69400
Wedge Disc	-	Bronze to ASTM B16
Hand wheel	-	Malleable Iron to ASTM A 47

The valve shall have a design pressure of 250 psi and a hydrostatic shell test pressure of 400 psi. The valves shall be threaded to ANSI B1.20.1.

The body, bonnet & disc of the gate valve shall be of Bronze C83600 / ASTM B62. The stem shall be of Stem shall be Silicon Bronze to ASTM B-371 Alloy C69400.

The valves shall be Hand wheel operated, Design to UL 262.

#### **4.13.2.3 Butterfly Valves**

##### **A. Design & Construction**

All butterfly valves shall be manufactured and tested in accordance with BS EN 593 / AWWA C 504 and its amendments. Butterfly valves shall be of flanged concentric type. Butterfly Valves shall be hand wheel (with worm gear where required) operated, electrically supervised type.

These valves shall have the following material of construction:

Body	-	Cast Iron to ASTM A126 Cl. B/Ductile Iron to A536 65-45-12
Shaft	-	Stainless Steel to A276 410/ A532 Gr.316
Disc	-	Stainless Steel to CF8M/ Bronze B148-C95300
Hand wheel	-	Cast Iron to ASTM A126 Cl.B

The valve body shall be flanged type with centric disc and one piece shaft supported by bronze radial bearing for smooth operation. The body of the valve shall be rubber lined. The liner shall extend along the face of the valve. The body parts shall be circular and the diameter not less than that of the nominal pipe bore. The valve body shall also be provided with suitable lifting lugs.

Valves shall be suitably designed to protect the disc edge from the effects of corrosion and erosion. The disc shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The disc shall be contoured to ensure the lowest possible resistance to flow and shall be suitable for throttling operation.

The shaft shall be designed to withstand the maximum torque that will be imposed by the operator. The means of attachment of the shaft to the disc shall be by using fixings in a homogeneous corrosion-resistant material of a pattern which precludes the assembly becoming loose in operational service. The shaft material shall be stainless steel.

The valves shall be designed to be drop tight in either direction at maximum differential pressure.



Valves shall be provided with suitable stops to prevent movement of the shaft beyond the limits corresponding to fully open and fully closed position of the disc. Epoxy coated inside and outside as per AWWA C550.

Extension spindles, headstocks and foot brackets shall be provided where specified. Headstocks shall incorporate a valve position indicator.

All butterfly valves shall be suitable for use with water temperature up to 50°C and in climate and soil conditions encountered in the State of Qatar.

All component parts of the valve body i.e. bonnet and stem seal housing shall be bolted together, where setscrews are used.

All butterfly valves shall be designed for clockwise closing and be marked accordingly.

All butterfly valve flanges shall be drilled to BS EN 1092-2, PN 16 or ANSI B 16.1 class 125.

The internal diameter of all valves at the end adjacent to the pipework shall be the same as the internal diameter of the connecting pipe.

All valve waterways shall be coated internally with a solvent free epoxy or polyester lining of 100% solid content to be applied at the place of manufacture. The lining shall be of 300 micron nominal thickness and holiday free.

All casting shall be properly finished, sand blasted and cleaned before coating.

Coating shall be smooth and mirror finish without any hairline cracks.

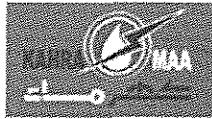
#### B. Operation

Hand operated valves shall be easily accessible and shall be operable by one man. All valves shall be closed by rotating the hand-wheel in a clockwise direction when looking at the face of the hand-wheel. The face of each hand wheel shall be clearly marked with the words "Open" and "Shut" in English and Arabic with adjacent arrows to indicate the direction of rotation to which each refers.

Unless otherwise specified each valve shall be provided with a suitable hand wheel of adequate diameter for the duty required and gearing shall be supplied where necessary to ensure that the required operating force applied by hand to the rim of the wheel does not exceed 25 kgf.

Each valve hand wheel shall be fitted with a circular nameplate of an approval material indicating in English and Arabic the valve reference number and function of the valve. The nameplates shall incorporate the color code corresponding to the particular service of the piping.

Hand wheels shall have smooth rims with the word 'CLOSE' and an arrow to indicate the direction of closing, which shall be clockwise, cast on them. Vandal and weatherproof clear polycarbonate tube covers shall be securely fitted to protect the threads of rising stems and spindles and tubes shall be clearly and permanently engraved to indicate the position of the valve.



### C. Testing

All valves shall be individually pressure tested at following hydraulic pressure:

Body – 24bar  
Seat – 17.6bar  
Disc – 24bar

A factory test certificate shall be issued for each butterfly valve giving its serial number in order to be submitted with the valves, if requested by the concerned Engineer.

The Contractor shall obtain the necessary installation drawings from the manufacturer and shall store, transport, handle and install the valves and appurtenances in strict accord with the manufacturer's drawings and recommendations. Care shall be taken during mounting of logs to avoid warping the frames and to maintain clearance between seating faces.

#### 4.13.2.4 Check Valves

Refer to Section 4.3.4 and comply with the requirements of check valves for DN≤300

#### 4.13.2.5 Studs, Bolts & Nuts

The material used for the manufacture of Stud Bolts and Nuts shall be in accordance with ASTM A 193 Gr. B7M for Bolts and ASTM A 194 Gr. 2HM for Nuts for general service.

Heat treatment for Stud Bolts and Nuts shall be carried out as per the relevant material specifications.

All bolting shall be made from Basic Oxygen or Electric Furnace Steel, which is vacuum treated. Bolting shall be coated. B7M bolting shall be heat treated by quenching in a liquid medium and tempering. Quenched and tempered material that is subsequently cold-drawn for dimensional control, shall be stress relieved after cold drawing.

#### A. Design

Nuts for Stud Bolts shall be American Standard Hexagonal Heavy series and double chamfered, two Nuts per Stud Bolt are required.

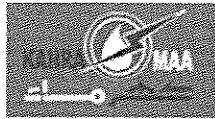
Dimensions and tolerances for Stud Bolts and Nuts shall be as per ASME B 18.2.1 and 18.2.2 with full threading to ASME B 1.1 Class 2A thread for Bolts and Class 2B for Nuts. Diameter and length of Stud Bolts shall be as per ASME B 16.5/MSS-SP-44 with full threading. Exceptions to this are Spacers, Spectacle Blinds, etc., where extra long Stud Bolts are required.

Threads for Stud Bolts shall be, as per ASME B 1.1 as follows:

for dia 1/4" to 1"	-	UNC 2A
for dia 1 1/8" to 3 1/4"	-	8UN-2A

Threads for Nuts shall be, as per ASME B1.1, as follows:

for Stud Bolts dia 1/4" to 1"	-	UNC 2B
for Stud Bolts dia 1 1/8" to 3 1/4"	-	8UN-2B



Jack Screws shall have heavy hexagonal type heads, with screwed end rounded.

Reduced shank stud bolts shall not be used.

#### **4.13.2.6 Gaskets**

##### **A. Material**

Material used for the manufacture of gaskets shall be suitable for fire water service. The type of gaskets shall be either metallic or Non-metallic as per recommendations of the valve manufacturer. The gaskets shall be full faced except where flat faced gaskets are recommended by manufacturer. The thickness of the gaskets shall be 3 mm.

Except where specified otherwise, the type of gaskets shall be used in piping flanges shall be EPDM (Ethylene Propylene Diene Monomer gaskets).

##### **B. Markings**

All gaskets shall be identified (branded) to guard against mis-application. Gaskets should be properly marked to ensure that there is no confusion between the different classes.

#### **4.13.2.7 Name Plate**

All Valves shall have a stainless steel Name Plate permanently affixed with stainless steel pan head screws. Each Name plate shall have, as a minimum, the following information stamped thereon:

Manufacturer  
Year of Manufacture  
Serial No.  
Tag No.  
Size

Other data required by Specifications, AWWA as applicable.

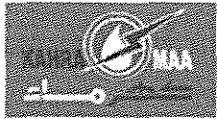
Material Traceability shall be in accordance with ISO 9000 and EN 10204 3.2.

#### **4.13.3 Inspection and Tests**

The Manufacturer shall perform all Inspection and Tests as per the requirements of this Specification and the relevant Codes at his Works prior to shipment. The cost of such Inspection and Tests shall be included in the Tendered Sum and shall comprise of, but not be limited to, the following:

##### **4.13.3.1 Visual Inspection**

Dimensional check on all Valves shall be carried out as per the Purchaser's approved drawings.



Chemical composition and mechanical properties, including hardness, shall be checked as per relevant material standards and this specification, for each heat of steel used.

- a) Non-Destructive examination of individual Valve material and components consisting, of but not limited to, castings, forgings and assembly welds, shall be carried out by the Manufacturer.
- b) Body castings of the Valves shall be radio graphically examined on 100% of the surface of critical areas as per ASME B 16.34. Procedures and acceptance criteria shall be as per ASME B 16.34. All castings shall be subject to wet magnetic particle inspection on 100% of the internal surfaces. Method and acceptance shall comply MSS-SP-53.
- c) All Valves, with forged bodies shall be ultrasonically examined, in critical areas, in accordance with the procedure and acceptance standard of Attachment - E of ASME B 16.34. All forgings shall be subject to wet magnetic particle inspection on 100% of their forged surfaces. Method and acceptance shall comply with MSS-SP-53.

All finished wrought weld ends, subject to welding in the field, shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the end. Laminations shall not be acceptable.

Weld ends of all cast Valves, subject to welding in the field, shall be 100% radio-graphically examined and acceptance criteria shall be as per ANSI B 16.34.

All Valves shall be hydrostatically tested in compliance with the requirements of relevant AWWA standards.

Kahramaa/ The Engineer also reserves the right to witness tests as indicated above at the Manufacturer's works, prior to the shipment. The Manufacturer shall give reasonable access and facilities required for inspection to Kahramaa's/ the Engineer's Inspector. Kahramaa/ The Engineer reserves the right to require additional testing, at any time, to confirm or further investigate, a suspected fault. The cost incurred shall be to the Manufacturer's account. In no case shall any action of Kahramaa/ the Engineer, or his Inspector, relieve the Manufacturer of his responsibility for material, design, quality or operation of the Valves. Inspection and tests performed/witnessed by Kahramaa's / the Engineer's Inspector shall in no way relieve the Manufacturer of his obligation to perform the required inspection and tests.

Kahramaa/ The Engineer may, at his discretion appoint a Third Party Inspection Agency to carry out inspection on behalf of, or together with, the Kahramaa's Inspector.

#### **4.13.4 Test Certificates**

Manufacturer shall submit the following certificates in accordance with EN 10204 3.1:

- Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the equipment construction as per the relevant standards.
- Test certificates for hydrostatic and pneumatic tests complete with duration and pressure records of each test.
- Test reports of radiography, ultrasonic, MPI and DP inspection.
- All other test reports and certificates as required by this Specification.



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The certificates shall be valid only when signed by the Kahramaa's / Engineer's Inspector. Only those Valves which have been certified by the Kahramaa's / Engineers Inspector shall be dispatched from the Manufacturer's works.

The Manufacturer's Serial No. and the Tag No. of the Valve shall provide a cross reference to all Documentation required in accordance with EN 10204.