

SUBCONTRACT AGREEMENT

This **Agreement** is made on 18 July 2023 by and between

1. **M/s Royal Advance Electromechanical LLC**, P.O. Box 11059, Abu Dhabi, UAE (hereinafter called "Contractor") and
2. **M/s Naffco Electromechanical Co. LLC-AbuDhabi**, Abu Dhabi, UAE (hereinafter called "Subcontractor")

For the performance of the **DESIGN, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF FIRE PROTECTION SYSTEM** for the **PROJECT: MEP WORKS FOR VARIOUS CONSTRUCTION IN AL HAIL AND QURAYYAH, ABU DHABI, UAE** (hereinafter called the "**Subcontract Works**") as per the following terms and conditions:

1. Definitions

- 1.1. In this Agreement the capitalized words and expressions shall have the following meaning:
 - (a) "**Authority**" means any competent governmental / legal entity, body or department having authority / jurisdiction with regards to the Project / Works.
 - (b) "**Employer**" means the person who has engaged the Contractor to carryout the Project / Works and legal successors in title to, or assignees of such person.
 - (c) "**Consultant**" / "**Engineer**" means the person appointed (from time to time) for the purpose of the Project / Works.
 - (d) "**Main Contractor**" means M/s Trojan General Contracting LLC.
 - (e) "**Main Contract**" means the contract entered between the Main Contractor and the Employer for the Project/Works, of which the Subcontract Works is an integral part.
 - (f) "**Contractor**" means the person named in this Agreement, the legal successors in title to this person and any assignee of such person.
 - (g) "**Subcontractor**" means the person named in this Agreement, the legal successors in title to this person, and any permitted assignee of such person.
 - (h) "**Party**" / "**Parties**" means either the Contractor or the Subcontractor or both as the context requires.
 - (i) "**Subcontract**" means this Agreement together with all other documents as per clause 5.1.
 - (j) "**Subcontract Works**" means the works which the Subcontractor is to carry out under the Subcontract.
 - (k) "**Works**" means the complete scope of works which the Main Contractor / Contractor is to carry out in respect of the Project under the Main Contract.
 - (l) "**Defects Notification Period**" means the period for notifying defects (if any) in the Subcontract Works as per clause 8.3.

2. Scope of Subcontract Works

- 2.1. The Subcontractor shall perform the **Subcontract Works** including design (as applicable), supply, installation, testing & commissioning, handing over on completion, and rectification of the defects (if any), in accordance with the Subcontract and as per the requirements, approval of the Contractor, Consultant/Engineer, Employer and the concerned Authorities.

The Subcontractor shall perform the Subcontract Works on back-to-back basis with the Project requirements whereby the Subcontractor shall undertake and assume all the obligations and liabilities of the Contractor related to the Subcontract Works so that the Contractor is able to discharge its obligations required for the Project.

- 2.2. The Subcontractor shall prepare and submit shop drawings, samples / materials technical submissions, method statements, risk assessment, project quality plan (PQP), as-built drawings, O&M manuals and other necessary documents, for approval of the materials intended to be incorporated and for the execution / completion and handing over of the Subcontract Works.

3. Subcontract Price and Payment Terms

- 3.1. In consideration of the performance of the Subcontract Works in accordance with the Subcontract Agreement, the Contractor shall pay to the Subcontractor Lumpsum amount **AED6,500,000.00 excluding VAT**, at the times and in the manner prescribed in the Subcontract Agreement.
- 3.2. The Subcontract Price is inclusive of any taxes (except UAE VAT), duties, fees, insurance, banking charges, accommodation, transportation and any other costs & expenses for the performance of the Subcontract Works.
- 3.3. The Subcontract Price shall account for all the necessary work / obligations / liabilities of the Subcontractor for the Subcontract Works and shall not be subject to adjustment for change in the cost of labour, equipment, materials for the performance of Subcontract Works, except for variations (if any).
- 3.4. Payment shall be made to Subcontractor as follows:
 - a) Advance Payment – not applicable.
 - b) Progress Payment (90%) – Payment certification shall be within 21days from receiving Subcontractor's payment application with supporting documents (including material / work inspection request approved by the Consultant). Payments to the Subcontractor shall be made through 120days Letter of Credit (LC) after approval of the Tax Invoice with supporting documents. For the LC charges - applicant's bank charges on the applicant account and beneficiary bank charges on the beneficiary's account.
 - 60% against materials delivery and approval thereof.
 - 20% against completion of installation.
 - 10% against testing and commissioning.
 - c) 10% Retention:
 - Initial 5% shall be released upon receipt of TOC/Authority Approval and
 - The remaining 5% shall be released upon completion of DLP or upon receipt of Approval against approved Bank Guarantee on Back-to-Back basis with Main Contract Terms and Conditions).
- 3.5. **Performance Security:** The Subcontractor shall provide performance security [UAE reputed and rated bank guarantee] for 10% of Subcontract Price, within 10 days after signing of this Subcontract Agreement. The performance security shall be valid until / returned after expiry of the Defects Notification Period and rectification of the defects, *if any*.

In case an expiry date is specified in the performance guarantee and 28 days prior to the expiry date the Defects Notification Period is not completed, then the Subcontractor shall be responsible to extend the validity of the guarantee.

The amount of the Performance Security shall be increased within 28 days of the written request from the Contractor so that it corresponds to any increase in the amount of the Subcontract Price adjusted pursuant to this Agreement and in such circumstances the Subcontractor shall provide an amended Performance Security in the correct amount within such period.

4. Variations

- 4.1. The Subcontractor shall undertake any variation (addition, omission, modification) to the Subcontract Works as may be instructed in writing by the Contractor. The Subcontractor shall proceed with the variation once the technical details have been confirmed by Contractor and the cost / time impact of such variation shall be finalized, as applicable.
- 4.2. Variation(s) shall be measured and valued at the BOQ rates or pro-rata thereto (as applicable). If the BOQ does not contain any rates or prices applicable to variation works, then suitable rates or prices shall be agreed between the Parties.
- 4.3. Variation submission(s) shall be forwarded by Contractor to the Consultant / Employer for approval upon timely receipt of Subcontractor's technical & commercial substantiation and time impact, as applicable.

5. Subcontract Documents

- 5.1. The following documents shall form part of the Subcontract. For the purpose of interpretation, in the event of conflict in these documents, the priority shall be in the sequence listed below. Notwithstanding above, if the documents impose different technical requirements for the Subcontract Works (including different standards of product, workmanship or finish) then the more stringent requirement, higher technical standard shall be applicable unless otherwise approved by the Employer:
- This Agreement
 - Annexure A - Specifications
 - Annexure B - Drawings
 - Annexure C - Bill of Quantities (BOQ)
 - Annexure D - Program of Subcontract Works
 - Annexure E - Subcontractor's Offer
 - Annexure F - Safety Violation Schedule
 - Annexure G - Form of Bank Guarantee
- 5.2. The documents forming the Subcontract shall be taken as mutually explanatory of one another. Any obligation / work required in one document but not mentioned in the other shall be responsibility of the Subcontractor.

6. Time for Completion

- 6.1. The Commencement Date shall be the date of signing this Agreement.
- 6.2. The Subcontractor shall proceed diligently and perform the Subcontract Works in accordance with program of Subcontract Works approved by the Contractor (Annexure D), which shall be in compliance with Project program / milestones (including any revisions thereto).
- 6.3. In case the procurement / supply of materials is delayed by Subcontractor, then the Contractor may notify the Subcontractor to take necessary measures within 10 days (or as otherwise agreed). If the Subcontractor fails to meet this condition, then the Contractor would have the option to procure the materials at the risk & cost of the Subcontractor and issue to Subcontractor for installation / incorporation.
- 6.4. In case the installation / execution of Subcontract Works is delayed by Subcontractor, then the Contractor may notify the Subcontractor to take necessary measures within 10 days (or as otherwise agreed). If the Subcontractor fails to meet this condition, then the Contractor would have the option to provide manpower / equipment for the execution of Subcontract Works at the risk & cost of the Subcontractor.
- 6.5. If the progress of Subcontract Works is at any time behind schedule for reasons attributable to the Subcontractor, then the Subcontractor shall be responsible to take necessary measures at its own cost to recover progress. If the Subcontractor fails to take necessary measures within 10 days (or as otherwise agreed) after notice from the Contractor, then the Contractor may omit any portion of the Subcontract Works and do it himself or through others and recover the additional costs / expenses from the Subcontractor.
- 6.6. In case the Subcontractor is unable to perform / complete the Subcontract Works within the completion time, for reasons attributable to Subcontractor, then the Contractor may charge to the Subcontractor 10% of the Subcontract Price ÷ 25% of the duration of Subcontract Works for each day of delay, up to a maximum of 10% of the Subcontract Price. The liquidated damages shall also be applicable on the interim milestones identified in the Program of Subcontract Works.

7. Extension of Time for Completion

- 7.1. If the Subcontractor is delayed in the performance of the Subcontract Works (for reasons not attributable to the Subcontractor) then the Subcontractor shall be entitled to claim extension of time for completion of the Subcontract Works, provided the delay is critical and the Subcontractor has taken all reasonable measures to mitigate delays.

- 7.2. The Subcontractor shall notify the Contractor within 7 days of the occurrence of the delay event and submit detailed particulars within 15 days of the occurrence of the delay event. Where the delay event has a continuing effect, the Subcontractor shall submit interim particulars at monthly interval and final particulars within 15 days after the end of the effects of the delay event. If the Subcontractor fails to give notice or submit the claim as described above, then the Subcontractor's claim for extension of time / prolongation cost may not be considered.
- 7.3. Where the Subcontract Works are delayed due to Consultant / Employer, then the Subcontractor's claim for extension of time / prolongation cost shall be subject to approval of the Employer.
- 7.4. The Subcontractor shall not be entitled extension of time, prolongation cost for the period of his concurrent delay. Furthermore, no prolongation cost shall be claimable for extension of time due to Force Majeure.

8. Warranty, Defects Liability, and Indemnity

- 8.1. The Subcontractor shall exercise reasonable skill, care and diligence in the performance of the Subcontract Works and upon completion the Subcontract Works shall comply with the requirements of the Subcontract and shall be fit for the intended purpose. The Subcontractor shall be liable for any error, omission, defect or insufficiency in the Subcontract Works or default of the Subcontractor.
- 8.2. Any part of the Subcontract Works that is not complying with the Subcontract shall be corrected and/or re-done by the Subcontractor. If the Subcontractor fails to carry out the rectification work within 10 days (or as otherwise agreed) after notice from the Contractor, then the Contractor may carry out the rectification work himself or through others at the risk & cost of the Subcontractor.
- 8.3. In general, the Subcontractor shall be liable to rectify any defect in the Subcontract Works (which is attributable to the Subcontractor) for a period of 365 days from the date of taking-over of the Subcontract Works by the Employer (the "Defects Notification Period / DNP").
- 8.4. The Subcontractor shall be liable for any defect in the Subcontract Works (which is attributable to the Subcontractor) during the warranty period(s) as applicable under the Subcontract and/or in accordance with applicable laws (the required warranty(ies) shall be provided by the Subcontractor when requested and in any case upon completion of the Subcontract Works).
- 8.5. Neither Party shall be liable to the other for any indirect or consequential losses, including inter alia loss of production, loss of use, loss of profit, loss of business etc. under the Subcontract except as otherwise may be applicable / enforceable under the law.
- 8.6. The Subcontractor shall indemnify the Contractor against any claims, damages arising out of or in relation to the Subcontract and which are attributable to the Subcontractor including any claims, damages, losses and expenses (including legal fees and expenses) in respect of:
 - (a) bodily injury, sickness, disease or death of any person whatsoever (including any person employed by the Subcontractor);
 - (b) damage to or loss of any property, real or personal;
 - (c) any breach of the copyrights / intellectual property rights of any third party; and
 - (d) any insufficiency or default in the Subcontract Works caused by the Subcontractor that may result in a liability for the Contractor under the Main Contract.

arising out of or in the course of or by reason of the Subcontractor's design (as applicable), the execution and completion of the Subcontract Works and remedying of any defects unless attributable to any breach of the Subcontract by the Contractor.
- 8.7. **Collateral Warranty:** If required by the Employer and within 10 days of the Contractor's request to do so, the Subcontractor shall provide Collateral Warranty (in the form approved by Employer), in favor of Employer and/or any Third Party (Funder, Purchaser, Tenant, Operator etc.) nominated by the Employer.

9. Insurance

- 9.1. The Subcontractor shall be responsible to arrange / maintain insurance as may be required under the applicable Laws and/or as may be necessary to cover its obligations / liabilities under the Subcontract; including Subcontractor's workmen compensation and/or equipment insurance, as applicable (*copy of the insurance shall be provided when requested*).
- 9.2. The Employer / Main Contractor shall provide Contractors All Risks & Third Party Liability (CAR/TPL) Insurance (*copy of the insurance shall be made available at site office for Subcontractor's review and record*).
- 9.3. In the event of claim / damages attributable to the Subcontractor, the Subcontractor shall be liable for the deductibles and/or any loss, damage which is not covered by the insurance.

10. Termination

- 10.1. The Subcontract may be terminated:
 - (a) If the contract of Contractor for the Project is terminated.
 - (b) If the approval of Subcontractor to perform the Subcontract Works and/or the Subcontract Works are withdrawn by the Consultant / Employer.
 - (c) If suspension / delay due to Force Majeure exceed 90 days.
 - (d) If the Subcontractor becomes bankrupt or insolvent or goes into liquidation.
 - (e) If the Subcontractor is in breach of Confidentiality provisions of this Subcontract.
- 10.2. Save for Subclause 10.1 above, in case the Subcontractor is in breach of the terms of the Subcontract and fails to rectify the breach within 10 days (or as otherwise agreed) after warning / notice from the Contractor, then the Contractor may at its sole option either terminate the Subcontract or omit / de-scope any portion of the Subcontract Works and do it himself or through others and recover the additional costs / expenses from the Subcontractor.
- 10.3. In case of termination of the Subcontract, the Subcontractor shall be paid for the Subcontract Works performed up to the date of termination, subject to approval of the Consultant / Employer, minus any damages / charges that may be applicable under the Subcontract or at Law.
- 10.4. The Subcontractor acknowledges and agrees that by signing this Subcontract Agreement, it consents to the termination mechanics under to this clause without the need to obtain a court order.

11. Force Majeure

- 11.1. "Force Majeure" shall mean an event which is beyond the control of the Party, not foreseeable and unavoidable. Such events shall include war, revolution, riot, natural disasters, fires, floods, epidemics / pandemics, quarantine restrictions, government control and freight embargoes, and the like events.
- 11.2. Neither Party shall be responsible for delay or non-performance of the Subcontract in case it is affected by Force Majeure. However, the Parties shall at all times use all reasonable endeavours to minimize any delay in the performance of the Subcontract as a result of Force Majeure.
- 11.3. If the Subcontractor is or shall be prevented from performing any of its obligations due to Force Majeure, then the Subcontractor shall immediately notify the Contractor in writing with details and specify the obligations which are or may be affected. The Subcontractor shall immediately notify the Contractor when it ceases to be affected by Force Majeure.

12. Miscellaneous Conditions

- 12.1. The Subcontractor shall provide necessary supervision, skilled & experienced manpower, tools, equipment (including PPE) and machinery required for the performance of the Subcontract Works. The record of Subcontractor's manpower and equipment at Project site shall be provided to the Contractor.

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- 12.2. The Subcontractor shall co-operate / co-ordinate as necessary with others working on the Project. The Subcontractor shall carry out its operations / works with reasonable skill, care and diligence as to cause no delay / disruption, injury, loss / damage to any person, materials, equipment, work or property.
 - 12.3. The Subcontractor shall comply with all the applicable HSE rules and regulations at Project site. In case of any violation(s), the Subcontractor may be charged the fines provided in the attached Safety Violation Schedule (Annexure F).
 - 12.4. The Subcontractor shall be provided with a designated space or yard at Project site (as available) to store his or the supplied materials for the Subcontract Works. The Subcontractor shall take full responsibility for the proper care, control and protection of the materials and the Subcontract Works from the commencement until the Subcontract Works have been taken over.
 - 12.5. Housekeeping, waste disposal related to its activities shall be done by the Subcontractor at all times. The Subcontractor shall leave the area of the completed Subcontract Works perfectly clean and fit for immediate use.
 - 12.6. The Contractor may assign the Subcontract or any part thereof. The Subcontractor shall not subcontract any part of the Subcontract Works or assign the Subcontract (or any part thereof) without prior written consent of the Contractor. The Subcontractor shall be responsible for its suppliers / subcontractors.
 - 12.7. **Confidentiality**
The Subcontractor shall treat the Subcontract, Subcontract documents and any documents and information provided directly or indirectly by the Contractor pursuant to the Subcontract, as private and confidential and, except where strictly necessary for the purpose of the Subcontract or as required by applicable Laws, shall not disclose the same to any third party without the prior written consent of the Contractor and only if such third party is placed under identical obligations of confidential and restrictions on use as the Subcontractor. The Subcontractor shall impose an equivalent conditions on all his subcontractors/suppliers.

This obligation of confidentiality shall not apply if:

- a) The information was known to the Subcontractor (as evidenced by his written record) prior to obtaining the same from the Contractor; or
- b) The information was in public domain prior to the time of disclosure to the Subcontractor or at any time thereafter comes into the public domain because of no fault of the Subcontractor; or
- c) The information is disclosed to the Subcontractor by a third party who did not receive the same, directly or indirectly, from the Contractor and who has, the best of the Subcontractor's knowledge, no obligation of secrecy with respect thereof.

Any potential press releases and/or information (including photographs, videos, Project Location/Details) to be supplied to news media (which includes for these purposes trade magazine, business journals, social media and/or any other platform) in relation to the Project, the Subcontract and/or the Works or any part thereof shall require the Contractor's/Employer's prior written approval. Any incompliance with this provision shall entitle the Contractor to seek the remedies of injunction, specific performance or other equitable relief in addition to remedies provided under the Subcontract.

13. Condition Precedent

- 13.1. Notwithstanding anything to the contrary, this Subcontract Agreement shall be rendered null & void should the Subcontractor's prequalification / approval to perform the Subcontract Works is rejected by the Consultant / Employer.
- 13.2. Upon submitting the signed / stamped Agreement, the Subcontractor shall same time submit copies of the following for review / records of the Contractor (the Subcontractor shall be responsible for keeping these documents in order and renew as the case may be upon expiry):
 - Valid Trade / Commercial / Registration License of the Subcontractor.
 - Power of Attorney / Authorization Letter of the Subcontractor's signatory.

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- Certificate of Tax (UAE VAT) Registration of the Subcontractor.

14. Governing Law and Dispute Resolution

- 14.1. The Subcontract shall be governed by and construed in accordance with the Laws of UAE as applicable in the Emirate where Project is located. The Subcontractor shall comply with all the applicable laws and rules & regulations in performance of the Subcontract / Subcontract Works.
- 14.2. In case of dispute between the Parties which is not resolved amicably within 30 days (or as otherwise agreed), then it may be referred to the competent Courts for final settlement.

The Parties hereto have caused this Agreement to be executed by their **duly authorized representatives** the day and year first before written:

Accepted & Signed for
M/s Royal Advance Electromechanical LLC

Accepted & Signed for
M/s Naffco Electromechanical Co. LLC-AbuDhabi

Engr. Wael Mansour
Chief Executive Officer

Name:
Position:

ANNEXURES TO THE AGREEMENT

1. ANNEXURE A – SPECIFICATIONS

Project Specifications related to the Subcontract Works (as listed in the attached Subcontract Tender Document and issued to the Subcontractor through TBMS portal) shall form part of this Annexure.

2. ANNEXURE B – DRAWINGS

Project Drawings related to the Subcontract Works (as listed in the attached Subcontract Tender Document and issued to the Subcontractor through TBMS portal) shall form part of this Annexure.

3. ANNEXURE C – BOQ / PRICE BREAKDOWN

As attached hereto.

4. ANNEXURE D – PROGRAM OF SUBCONTRACT WORKS

As attached hereto.

5. ANNEXURE E – SUBCONTRACTOR'S OFFER

Subcontractor's Offer including Clarifications/Addendums (if any), Specific Tasks Compliance Sheet, and Responsibility Matrix shall form part of this Annexure. However, in case of conflict between the terms and conditions between this Agreement and the Subcontractor's Offer, the terms and conditions of this Agreement shall prevail.

6. ANNEXURE F – SAFETY VIOLATION SCHEDULE

No.	Safety Violation	Fine
<i>Very High Risk Violations</i>		
1	Working on incomplete scaffold.	AED 5,000
2	Working at height without standard and approved edge protection or safety harness	AED 5,000
3	Improper electrical connections and cables for machines and tools/cable road crossing	AED 5,000
4	Using lifting gears and cranes without valid certificates of equipment and people	AED 5,000
5	Usage of rotating equipment/machineries and electrical tools without guard.	AED 5,000
<i>High Risk Violations</i>		
6	Workmen performing job in a dangerous manner. Likely to cause major or fatal injury to self or others	AED 1,000
7	Failure to provide trench protection for deep excavation.	AED 1,000
8	Driving vehicles and equipments without valid license and certificates	AED 1,000
9	Insufficient lighting for night work	AED 1,000
10	Insufficient distance between trench and road/heavy vehicle movement area	AED 1,000
11	No rebar caps on protruding rebars less than 1.5 meter	AED 1,000
12	No certified riggers	AED 1,000
13	Non compliance with other authority requirements	AED 1,000
14	No proper and approved fire protection system for offices and equipments	AED 1,000
15	Any activity carried out by untrained personnel wherever required by Law	AED 1,000
16	Using unsafe access to trench	AED 500
17	Using non standard ladders	AED 500
18	Waste not kept segregated and not kept in identified place.	AED 500
<i>Medium Risk Violations</i>		
19	DG set at site without containment facility, fire safety measures and metallic shade	AED 500
20	Unhygienic conditions of welfare facilities (rest area, toilets and drinking water cooler)	AED 500
21	Stock pile not covered/not watered to avoid dust	AED 500
22	Discharge of water to sea without sedimentation	AED 500
23	Improper housekeeping on site / spillage of trash	AED 500
24	Working under suspended loads	AED 500
25	Non-compliance of approved HSE plan, method statement and risk assessment	AED 500
<i>Low Risk Violations</i>		
26	Washing of concrete mixer at unauthorized place	AED 250
27	Putting waste/debris/concrete in the unauthorized area	AED 250
28	Smoking at work area	AED 250
29	Spillage of diesel / oil in the site	AED 250
30	Usage of machineries at site with abnormal emissions, noise and leakage	AED 250

No.	Safety Violation	Fine
31	Oil changing/repairing activities at site without any measures for spillage protection	AED 250
32	Shifting of rebars, or non standard handling of heavy loads using JCB (double fine next time)	AED 250
33	Violating alcohol and drug policy	AED 250
34	Not conducting tool box talk by foreman / supervisor	AED 250
35	Working at site before getting HSE induction from Trojan	AED 250
36	Inadequate signage	AED 250
37	PPE violations	AED 100
38	Speeding at site beyond the limit	AED 100
39	Fighting in Project site area	AED 100
40	Littering on site	AED 100
41	Any fine by Employer / Authorities attributable to the Subcontractor	As per actual

7. ANNEXURE G – FORM OF BANK GUARANTEE

FORM OF PERFORMANCE GUARANTEE

Beneficiary:

Dear Sir,

At the request of M/s P.O. Box (hereinafter called "Subcontractor"), we (Bank) hereby undertake to guarantee the payment of AED as a maximum which represents the amount of performance security under Subcontract Ref.

We undertake to pay you any sum up to the amount mentioned above upon your first written demand stating that the Subcontractor has failed to fulfill the terms and conditions of the Subcontract, notwithstanding the existence of any dispute whatsoever and/or objections of the Subcontractor.

This guarantee shall come into force on the date hereof and shall be valid until (date) or until you advise us in writing that the Subcontractor has fulfilled all its obligations under the Subcontract (whichever is the earlier), after which date our liability shall automatically cease.

Claims, if any, under this guarantee must be presented to us through your bankers with your signature(s) on the claim letter duly verified by them, along with the original guarantee and amendments, if any. This guarantee shall be governed by and interpreted in accordance with the Laws of United Arab Emirates as applicable in the Emirate of Abu Dhabi.

Yours faithfully,
For Bank

---END OF ANNEXURES---

066112/16-22

06-Jul-2023

M/s. ROYAL ADVANCED

ABU DHABI

Tel. :

Fax : mohammad.sabeq@royaladvance.ae

Project : CMW-21073-B001

Subject : QUOTATION FOR SUPPLY, INSTALLATION OF FIRE PROTECTION SYSTEM EQUIPMENT

Consultant : Directorate Of Military Works / CMW

Client : CMW

Att. : MR. MOHAMMAD SABEQ

Dear Sir ,

****AS PER DRAWING WITH ERW PIPES****

Thank you for your enquiry. Please find our offer for the above mentioned project for Supply, Installation of PUMP SET, SPRINKLER, FIRE FIGHTING, FM200, FOAM , WATER SPRAY SYSTEM EQUIPMENT. We have considered listed equipment's in our offer as per Civil Defense regulations.

SN.	System Description	Price
1	NAFFCO UL LISTED HORIZONTAL SPLIT CASE FIRE PUMP SET FLOW 2500 GPM @ 12 BAR (1 NO. ELECTRIC + 1 NO. DIESEL W/ 1 NO. JOCKEY FLOW)- SITE 1	AED 439,750.00
2	NAFFCO UL LISTED HORIZONTAL SPLIT CASE FIRE PUMP SET FLOW 2500 GPM @ 12 BAR (1 NO. ELECTRIC + 1 NO. DIESEL W/ 1 NO. JOCKEY FLOW) - SITE 2	AED 439,750.00
3	SPRINKLER SYSTEM - SERVICE BUILDING - SITE 1 (GF)	AED 90,105.00
4	SPRINKLER SYSTEM - HANGAR AREA - SITE 1	AED 67,775.00
5	SPRINKLER SYSTEM - SERVICE BUILDING(2A)- SITE 2 (B+GF)	AED 92,214.00
6	SPRINKLER SYSTEM - SERVICE BUILDING(2B)- SITE 2 (GF)	AED 27,309.00
7	SPRINKLER SYSTEM -HANGAR AREA - SITE 2 <<<TOTAL OF 2 AREAS>>>	AED 135,550.00
8	FIRE FIGHTING SYSTEM - SITE 1	AED 1,129,278.00
9	FIRE FIGHTING SYSTEM -HANGAR AREA -SITE 1	AED 14,460.00
10	FIRE FIGHTING SYSTEM - SITE 2	AED 1,474,048.00
11	FIRE FIGHTING SYSTEM -HANGAR AREA -SITE 2<<<TOTAL OF 2 AREAS>>>	AED 35,158.00
12	FIRE EXTINGUISHERS - SERVICE BUILDING -SITE 1 (GF)	AED 6,229.00
13	FIRE EXTINGUISHERS - SERVICE BUILDING(2A)-SITE 2 (B+GF)	AED 7,298.00
14	FIRE EXTINGUISHERS - SERVICE BUILDING(2B) -SITE 2 (GF)	AED 652.00
15	DELUGE SUPPRESSION SYSTEM - SITE 1	AED 1,089,386.00
16	DELUGE SUPPRESSION SYSTEM - SITE 2	AED 477,183.00
17	FM-200 FIRE SUPPRESSION SYSTEM - MV ROOM @ GF TUNNEL SERVICE BUILDING (SITE 1)- VOLUME 171 M3	AED 50,371.00
18	FM-200 FIRE SUPPRESSION SYSTEM - LV ROOM @ GF TUNNEL SERVICE BUILDING (SITE 1)- VOLUME 1001 M3	AED 182,183.00
19	FM-200 FIRE SUPPRESSION SYSTEM - BATTERY ROOM @ GF TUNNEL	AED 45,289.00



SN.	System Description	Price
	SERVICE BUILDING (SITE 1)- VOLUME 116 M3	
20	FM-200 FIRE SUPPRESSION SYSTEM - ELV/COMM ROOM @ GF TUNNEL SERVICE BUILDING (SITE 1)- VOLUME 303 M3	AED 65,752.00
21	FM-200 FIRE SUPPRESSION SYSTEM - MV ROOM @ GF TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 165 M3	AED 49,596.00
22	FM-200 FIRE SUPPRESSION SYSTEM - LV ROOM @ GF TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 814 M3	AED 142,453.00
23	FM-200 FIRE SUPPRESSION SYSTEM - ELV/COMM ROOM @ GF TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 380 M3	AED 70,430.00
24	FM-200 FIRE SUPPRESSION SYSTEM - BATTERY ROOM @ GF TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 132 M3	AED 45,819.00
25	FM-200 FIRE SUPPRESSION SYSTEM - ELEC ROOM @ GF TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 259 M3	AED 55,761.00
26	FOAM SYSTEM - GENERATOR ROOM @ GF TUNNEL SERVICE BUILDING (SITE 1)- VOLUME 99 M3	AED 72,898.00
27	FOAM SYSTEM - GENERATOR ROOM @ GF TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 142 M3	AED 73,828.00
28	HIGH VELOCITY SPRAY SYSTEM - TRANSFORMER ROOM @ GF TUNNEL SERVICE BLOCK - SITE 1	AED 38,129.00
29	HIGH VELOCITY SPRAY SYSTEM - TRANSFORMER ROOM @ GF TUNNEL SERVICE BLOCK - SITE 2	AED 38,129.00
30	SPARE PARTS FOR PUMP SET	AED 12,000.00
31	SPRINKLER SYSTEM - SPARE PARTS	AED 672.00
32	SPARE PARTS FOR FIRE FIGHTING SYSTEM	AED 5,035.00
33	SPARE PARTS FOR HIGH VELOCITY SPRAY SYSTEM	AED 8,586.00
34	SPARE PARTS FOR FOAM SYSTEM	AED 881.00
35	SPARE PARTS FOR FM200 SYSTEM	AED 2,600.00
36	FIRE FIGHTING SYSTEM - TUNNEL SERVICE BUILDING SITE - 1	AED 15,149.00
37	FIRE FIGHTING SYSTEM - TUNNEL SERVICE BUILDING SITE - 2 [2A & 2B]	AED 23,844.00
38	<<OPTIONAL OFFER>> SEISMIC	AED 390,000.00
39	<<OPTIONAL OFFER>> GI & FLEXIBLE CONDUITS	AED 682,500.00
40	PUDDLE FLANGE & ANTI VORTEX PLATE	AED 26,000.00
41	EXHAUST PIPING	AED 26,000.00
Total		AED 6,577,550.00
Discount		AED 77,550.00
Net Total		AED 6,500,000.00

VAT at 5% (To be paid Immediately) :

325,000.00

We earnestly hope that you will find our rates & terms-conditions of business most competitive & acceptable to you. We look forward to your esteemed order & assure you our utmost attentions & cooperation all the time.

Best Regards,

Engr. Mohammad Assaf
General Manager

Engr. Taha Haniya
Sales & Marketing Director

Eng.No : 067/22 ERW *J FF (JM/SJ/B)

Project No : 33001300922

Opportunity No : 0930577

TRN Number : 100039127400003

Note : For further clarifications, Please Contact our representative Mohammad
Saleh El.Uthman on 971554466120

3 /



TECHNICAL STUDY

ENG REF	067/22	REV:	0	DATE:	06.07.2023
PROJECT	CMW-21073-B001.				

Technical Notes and Comments: -

Offer is based on the drawings provided by you.

Pipes & Fittings: - Included as per specification

Exclusions:

1. Fuel Filtration system is not included under Naffco scope of work.
2. All civil works.
3. Valve chambers for underground valves.
4. Pipe sleeves for wall crossings.
5. Design and installation of Seismic bracings is NOT included in our proposal irrespective of its requirements in tender documents. It will be provided as a Separate Offer in case it is required in future by contractor/consultant/client to be included under NAFFCO scope of work.
6. Any kind of spare parts for the proposed firefighting & fire extinguishing systems are not included.
7. PVC/GI conduits in fire extinguishing systems.
8. Drop curtains, Motor operated dampers, Door holders and any other shutdowns required for the proposed Gas suppression / foam systems.
9. Discharge test, Pressure relief/Room venting system for the proposed Gas suppression/foam systems.
10. Reserve for the proposed Gas suppression or foam system.
11. Any extra requirements in future by civil defense due to amendments of current UAE code shall be considered as variation.
12. Temporary firefighting system for the project during execution.
13. House of expert fees/ civil defense fees.
14. Any kind of VAT or other taxes levied by government of UAE is excluded in our offer and same shall be paid by Client.

Observations:

1. Any additional material / equipment's required during detailed engineering / execution as per the requirements of Civil Defense/Site condition will be charged extra.
2. Incoming power supply to the Extinguishing Panels shall be provided by you along with necessary isolator / MCB and proper earthing.
3. Interfacing of the extinguishing panel with any other systems are not considered in our offer, however provision for the same are available.



TECHNICAL STUDY

4. Presumed that the Hazard area protected by clean agent system is air tight and sealing & securing of the protected spaces are NOT in our scope of work.
5. Assumed the temperature in all room enclosures and cylinder storage areas were maintained at temperatures as advised by the manufacturer.

Deviation:

1. Proposed CO2 fire extinguishers are 5 kg only, whereas drawing shows 6 Kg CO2 fire extinguisher in site-1 Drawing.

The Estimation is based on the drawings and specification as per **Annexure -A**

Annexure -A

S.NO	DRWG NO.	DRAWING TITLE	REV	DATED
1	NAF-SD-FF-PLN-0001	FIRE FIGHTING SYSTEM SCHEMATIC FOR SITE – 1	0	23.12.2022
2	NAF-SD-FF-PLN-0002	SPRINKLER & FIRE FIGHTING SYSTEM FOR TUNNEL SERVICE BUILDING SITE – 1	0	23.12.2022
3	NAF-SD-FF-PLN-0003	STANDPIPE & FIRE EXTINGUISHING SYSTEM FOR TUNNEL SITE – 1	0	23.12.2022
4	NAF-SD-FF-PLN-0004	DELUGE WATER SPARYSYSTEM FOR TUNNEL SITE – 1	0	23.12.2022
5	NAF-SD-FF-PLN-0008	FIRE FIGHTING SYSTEM SCHEMATIC FOR SITE - 2	0	23.12.2022
6	NAF-SD-FF-PLN-0009	SPRINKLER & FIRE FIGHTING SYSTEM FOR TUNNEL SERVICE BUILDING 2A & 2B SITE – 2	0	23.12.2022
7	NAF-SD-FF-PLN-0009	SPRINKLER & FIRE FIGHTING SYSTEM FOR TUNNEL SERVICE BUILDING 2A & 2B SITE – 2	0	23.12.2022
8	NAF-SD-FF-PLN-0009	SPRINKLER & FIRE FIGHTING SYSTEM FOR TUNNEL SERVICE BUILDING 2A & 2B SITE – 2	0	23.12.2022
9	NAF-SD-FF-PLN-0010	STANDPIPE & FIRE EXTINGUISHING SYSTEM FOR TUNNEL SITE – 2	0	23.12.2022
10	NAF-SD-FF-PLN-0011	DELUGE WATER SPARYSYSTEM FOR TUNNEL SITE – 2	0	23.12.2022

Prepared By: Guna

Page: 2

Approved By: Muneer Raza

TERMS & CONDITIONS FOR SUPPLY AND INSTALLATION

TOTAL PRICE OF OFFER W/ OUT OPTIONAL (AFTER DISCOUNT) :
Dhs.6,500,000.00/-

METHOD OF PAYMENT : To be mutually agreed.

INSTALLATION & SUPERVISION : Included
[Pipes & Fittings used is UL Listed & ADCD Approved in this Projected]
TESTING & COMMISSIONING : Included

DELIVERY & INSTALLATION : To be mutually agreed.

WARRANTY: As per NAFFCO standard warranty. One year from the date of Testing and Commissioning. Warranty covers only limited to changing or replacing defected parts free of charge and does not cover misuse or mishandling of equipment. Warranty does not cover damage to fire pump set due to dry run.

VALIDITY OF OFFER : 21 days from the date of offer.

This quotation is only valid for the total price and quantity stated in our offer.

Notes:-

" We reserve the rights to correct prices in case of any typographic or arithmetic errors. Any additional works/items in deviation to our approved offer shall be considered as a variation with mutually agreed cost and time.

" Any cancelation of LPO/materials after 2 weeks from Its Date, will be charged 30% upon cancelation in case materials are ready for delivery.

" Delivery schedule to be confirmed after receiving LPO copy along with latest approved CD/ Consultant. against Drawings/ Materials

Note:- "The price stated herein shall be exclusive of any taxes imposed by the government and shall be charged separately"

Works/Items not included in our offer.

- A. Fire rated cable, cable tray and other accessories for connecting isolator to the fire pump controller
- B. Sleeves and Fire Stops
- C. Electrical Power and water.
- D. All civil works i,e excavation, back filling, compacting, asphalting, sand and sand laying, concreting, holding etc.
- E. Provision of power supply adjacent to controller / FACP.
- F. Items not mentioned in our offer but required by the consultant or Civil Defence.
- G. Scaffolding , Conduits ,Seismic & Integration with Hassantuk.
- H. Site Office & AMC

- I. House of Experts/Civil Defence Fees.
- J. Civil Defence certificate will be signed only after receiving 95% of the contract value.
- K. Integrity Test.
- L. Cladding & Installation works for diesel engine driven pump exhaust pipe.
- M. Value Added Tax (VAT)

- 1 NAFFCO UL LISTED HORIZONTAL SPLIT CASE FIRE PUMP SET
 FLOW 2500 GPM @ 12 BAR (1250 GPM @ 12 BAR 2 NO. ELECTRIC
 + 2 NO. DIESEL W/ 1 NO. JOCKEY FLOW 25GPM @ 12 BAR) -
 SITE 1

BRAND: NAFFCO, U.A.E

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	NAFFCO UL LISTED HORIZONTAL SPLIT CASE FIRE PUMP SET, FLOW: 2500 GPM @ 12 BAR (1250 GPM @ 12 BAR 2 NO. ELECTRIC + 2 NO. DIESEL W/ 1 NO. JOCKEY FLOW 25GPM @ 12 BAR) C/W: INDIVIDUAL PUMP CONTROLLERS AS PER NFPA 20	1	SET	320,000.00	320,000.00
2	ADDITIONAL VALVES FOR ABOVE MENTIONED PUMP SET	1	LOT	54,000.00	54,000.00
3	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES.	1	LS	65,750.00	65,750.00
Total Price for the above:					439,750.00

NOTE:

WE HAVE NOT INCLUDED RE-CIRCULATING PUMP.

- 2 NAFFCO UL LISTED HORIZONTAL SPLIT CASE FIRE PUMP SET
 FLOW 2500 GPM @ 12 BAR (1250 GPM @ 12 BAR 2 NO. ELECTRIC
 + 2 NO. DIESEL W/ 1 NO. JOCKEY FLOW 25GPM @ 12 BAR) -
 SITE 2

BRAND: NAFFCO, U.A.E

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	NAFFCO UL LISTED HORIZONTAL SPLIT CASE FIRE PUMP SET, FLOW: 2500 GPM @ 12 BAR (1250 GPM @ 12 BAR 2 NO. ELECTRIC + 2 NO. DIESEL W/ 1 NO. JOCKEY FLOW 25GPM @ 12 BAR) C/W: INDIVIDUAL PUMP CONTROLLERS AS	1	SET	320,000.00	320,000.00

2 NAFFCO UL LISTED HORIZONTAL SPLIT CASE FIRE PUMP SET
 FLOW 2500 GPM @ 12 BAR (1250 GPM @ 12 BAR 2 NO. ELECTRIC
 + 2 NO. DIESEL W/ 1 NO. JOCKEY FLOW 25GPM @ 12 BAR) -
 SITE 2

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
PER NFPA 20					
2	ADDITIONAL VALVES FOR ABOVE MENTIONED PUMP SET	1	LOT	54,000.00	54,000.00
3	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES.	1	LS	65,750.00	65,750.00
Total Price for the above:				439,750.00	

3 SPRINKLER SYSTEM - SERVICE BUILDING - SITE 1 (GF)

BRAND: SHIELD

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
1	UPRIGHT SPRINKLER HEAD, ½" ORIFICE X ½" NPT INLET, GLASS BULB TYPE, K-5.6, 68°C, BRASS FINISH, STD. RESPONSE	58	NOS	12.00	696.00
2	ALARM VALVE ASSEMBLY 4" FLANGE TYPE, VERTICAL BASIC TRIM, RETARD CHAMBER, MOTOR ALARM GONG & PRESSURE SWITCH	1	SET	3,135.00	3,135.00
3	OS & Y GATE VALVE 4" W/ TAMPER SWITCH	1	NOS	953.00	953.00
4	6" X 4 WAY BREACHING INLET - KITE MARK	1	NOS	855.00	855.00
5	BREACHING INLET CABINET, SURFACE TYPE, COMPLETE STAINLESS STEEL BACK BOX, FRAME & DOOR WITH WIRED GLASS FRONT	1	NOS	932.00	932.00
6	NON RETURN VALVE 6"	1	NOS	1,229.00	1,229.00
7	AIR RELEASE VALVE 1"	1	NOS	39.00	39.00

3 SPRINKLER SYSTEM - SERVICE BUILDING - SITE 1 (GF)

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
8	PRESSURE GAUGE W/ ISOLATION VALVE	1	NOS	85.00	85.00
9	PRV ASSEMBLY C/W 8"	1	NOS	26,000.00	26,000.00
10	OS & Y GATE VALVE 12"	2	NOS	4,472.00	8,944.00
11	PIPING[ERW SCH 40], INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	47,237.00	47,237.00
Total Price for the above:					90,105.00

4 SPRINKLER SYSTEM - HANGAR AREA - SITE 1**BRAND: SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	UPRIGHT SPRINKLER HEAD, ½" ORIFICE X ½" NPT INLET, GLASS BULB TYPE, K-5.6, 68°C, BRASS FINISH, QUICK. RESPONSE	84	NOS	15.00	1,260.00
2	ALARM VALVE ASSEMBLY 4" FLANGE TYPE, VERTICAL BASIC TRIM, RETARD CHAMBER, MOTOR ALARM GONG & PRESSURE SWITCH	1	SET	3,135.00	3,135.00
3	OS & Y GATE VALVE 4" W/ TAMPER SWITCH	1	NOS	953.00	953.00
4	6" X 4 WAY BREACHING INLET - KITE MARK	1	NOS	855.00	855.00
5	BREECHING INLET CABINET, SURFACE TYPE, COMPLETE STAINLESS STEEL BACK BOX, FRAME & DOOR WITH WIRED GLASS FRONT	1	NOS	932.00	932.00
6	NON RETURN VALVE 6"	1	NOS	1,229.00	1,229.00
7	AIR RELEASE VALVE 1"	1	NOS	39.00	39.00
8	PRESSURE GAUGE W/ ISOLATION VALVE	1	NOS	85.00	85.00
9	PIPING [ERW SCH 40], INSTALLATION, TESTING	1	LOT	59,287.00	59,287.00

4 SPRINKLER SYSTEM - HANGAR AREA - SITE 1

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
& COMMISSIONING CHARGES					
Total Price for the above:					67,775.00

5 SPRINKLER SYSTEM - SERVICE BUILDING(2A)- SITE 2 (B+GF)**BRAND: SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	UPRIGHT SPRINKLER HEAD, ½" ORIFICE X ½" NPT INLET, GLASS BULB TYPE, K-5.6, 68°C, BRASS FINISH, STD. RESPONSE	80	NOS	12.00	960.00
2	ALARM VALVE ASSEMBLY 4" FLANGE TYPE, VERTICAL BASIC TRIM, RETARD CHAMBER, MOTOR ALARM GONG & PRESSURE SWITCH	1	SET	3,135.00	3,135.00
3	OS & Y GATE VALVE 4" W/ TAMPER SWITCH	1	NOS	953.00	953.00
4	ZONE CONTROL VALVE ASSEMBLY 4" C/W: BUTTERFLY VALVE, FLOW SWITCH, TEST AND DRAIN VALVE	2	SET	1,717.00	3,434.00
5	PRESSURE GAUGE	2	NOS	65.00	130.00
6	6" X 4 WAY BREACHING INLET - KITE MARK	1	NOS	855.00	855.00
7	BREECHING INLET CABINET, SURFACE TYPE, COMPLETE STAINLESS STEEL BACK BOX, FRAME & DOOR WITH WIRED GLASS FRONT	1	NOS	932.00	932.00
8	NON RETURN VALVE 6"	1	NOS	1,229.00	1,229.00
9	AIR RELEASE VALVE 1"	1	NOS	39.00	39.00
10	PRESSURE GAUGE W/ ISOLATION VALVE	1	NOS	85.00	85.00
11	PRV ASSEMBLY C/W 8"	1	NOS	26,000.00	26,000.00

5 SPRINKLER SYSTEM - SERVICE BUILDING(2A)- SITE 2 (B+GF)

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
12	OS & Y GATE VALVE 12"	2	NOS	4,472.00	8,944.00
13	PIPING[ERW SCH 40], INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	45,518.00	45,518.00
Total Price for the above:					92,214.00

6 SPRINKLER SYSTEM - SERVICE BUILDING(2B)- SITE 2 (GF)**BRAND: SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	UPRIGHT SPRINKLER HEAD, ½"ORIFICE X ½" NPT INLET, GLASS BULB TYPE, K-5.6, 68°C, BRASS FINISH, STD. RESPONSE	30	NOS	12.00	360.00
2	ALARM VALVE ASSEMBLY 4" FLANGE TYPE, VERTICAL BASIC TRIM, RETARD CHAMBER, MOTOR ALARM GONG & PRESSURE SWITCH	1	SET	3,135.00	3,135.00
3	OS & Y GATE VALVE 4" W/ TAMPER SWITCH	1	NOS	953.00	953.00
4	AIR RELEASE VALVE 1"	1	NOS	39.00	39.00
5	PRESSURE GAUGE W/ ISOLATION VALVE	1	NOS	85.00	85.00
6	PIPING[HDPE/ERW SCH 40], INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	22,737.00	22,737.00
Total Price for the above:					27,309.00

7 SPRINKLER SYSTEM -HANGAR AREA - SITE 2 <<<TOTAL OF 2 AREAS>>>

BRAND: SHIELD

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	UPRIGHT SPRINKLER HEAD, ½"ORIFICE X ½" NPT INLET, GLASS BULB TYPE, K-5.6, 68°C, BRASS FINISH, QUICK. RESPONSE	84	NOS	15.00	1,260.00
2	ALARM VALVE ASSEMBLY 4" FLANGE TYPE, VERTICAL BASIC TRIM, RETARD CHAMBER, MOTOR ALARM GONG & PRESSURE SWITCH	1	SET	3,135.00	3,135.00
3	OS & Y GATE VALVE 4" W/ TAMPER SWITCH	1	NOS	953.00	953.00
4	6" X 4 WAY BREACHING INLET - KITE MARK	1	NOS	855.00	855.00
5	BREECHING INLET CABINET, SURFACE TYPE, COMPLETE STAINLESS STEEL BACK BOX, FRAME & DOOR WITH WIRED GLASS FRONT	1	NOS	932.00	932.00
6	NON RETURN VALVE 6"	1	NOS	1,229.00	1,229.00
7	AIR RELEASE VALVE 1"	1	NOS	39.00	39.00
8	PRESSURE GAUGE W/ ISOLATION VALVE	1	NOS	85.00	85.00
9	PIPING [ERW SCH 40], INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	59,287.00	59,287.00
10	ADDITIONAL PRICE FOR ONE MORE AREA, SAME AS ABOVE	1	LS	67,775.00	67,775.00
Total Price for the above:					135,550.00

8 FIRE FIGHTING SYSTEM - SITE 1

BRAND: NAFFCO/SHIELD

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)

8 FIRE FIGHTING SYSTEM - SITE 1

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	DOUBLE COMPARTMENT FIRE HOSE CABINET (EMPTY), RECESSED TYPE, COMPLETE 304 STAINLESS STEEL BACK BOX, 304 STAINLESS STEEL ARCHITRAVE & DOOR, BRUSH FINISH - NAFFCO	30	NOS	1,985.00	59,550.00
2	2 1/2" LANING VALVE W/ BUILT IN PRV	30	NOS	581.00	17,430.00
3	2 1/2" X 30 MTR. LONG FIRE HOSE C/W: 2 1/2" NOZZLE	30	NOS	601.00	18,030.00
4	CO2 FIRE EXTINGUISHER 5KG- KITEMARK	70	NOS	209.00	14,630.00
5	DRY POWDER EXTINGUISHER 6KG -KITEMARK	40	NOS	117.00	4,680.00
6	FOAM FIRE EXTINGUISHER 9LTR - KITEMARK	30	NOS	149.00	4,470.00
7	DOUBLE FIRE EXTINGUISHERS CABINET (EMPTY), RECESSED TYPE, COMPLETE 304 STAINLESS STEEL BACK BOX, 304 STAINLESS STEEL FRAME & DOOR, MIRROR FINISH (TO ACCOMMODATE 2 NO. PORTABLE TYPE EXTINGUISHER)- NAFFCO	40	NOS	1,215.00	48,600.00
8	8" OS & GATE VALVE WITH TAMPER SWITCH	1	NOS	2,137.00	2,137.00
9	BUTTERFLY VALVE 8"	16	NOS	1,125.00	18,000.00
10	AIR RELEASE VALVE 1"	16	NOS	257.00	4,112.00
11	PRESSURE GAUGE WITH ISOLATION VALVE	16	NOS	85.00	1,360.00
12	DRAIN VALVE 2"	4	NOS	667.00	2,668.00
13	PIPING (ERW SCH 40), INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	933,611.00	933,611.00

Total Price for the above: **1,129,278.00**

NOTE:

FIRE PROTECTION SYSTEMS INSIDE THE STORES (FUNNEL AREA) IS NOT INCLUDED IN NAFFCO SCOPE OF WORK.

9 FIRE FIGHTING SYSTEM -HANGAR AREA - SITE 1**BRAND: NAFFCO/SIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	EMPTY DOUBLE COMPARTMENT FIRE CABINET, RECESSED TYPE, MILD STEEL BACK BOX, STAINLESS STEEL ARCHITRAVE & DOOR - NAFFCO	1	NOS	1,188.00	1,188.00
2	FIRE HOSE REEL 1" X 30 MTR. LONG, AUTOMATIC C/W: 1" INLET VALVE & 1" JET/SPRAY/SHUT NOZZLE - KITEMARK	1	NOS	536.00	536.00
3	LOCK SHIELD VALVE 1"	1	NOS	41.00	41.00
4	PRESSURE REDUCING VALVE 1"	1	NOS	115.00	115.00
5	2 1/2" LANDING VALVE W/ BUILT IN PRV	1	NOS	581.00	581.00
6	FIRE HOSE 2 1/2" X 30 MTRS C/W: 2 1/2" NOZZLE	1	NOS	601.00	601.00
7	CO2 FIRE EXTINGUISHER 5KG - KITEMARK	4	NOS	209.00	836.00
8	DRY POWDER EXTINGUISHER 6KG -KITEMARK	4	NOS	117.00	468.00
9	BREECHING INLET 6" X 4 WAY - KITEMARK	1	NOS	855.00	855.00
10	BREECHING INLET CABINET, SURFACE TYPE, COMPLETE STAINLESS STEEL BACK BOX, FRAME & DOOR WITH WIRED GLASS FRONT	1	NOS	932.00	932.00
11	NON RETURN VALVE 6"	1	NOS	1,229.00	1,229.00
12	OS & Y GATE VALVE 3" WITH TAMPER SWITCH	1	NOS	878.00	878.00
13	AIR RELEASE VALVE 1"	1	NOS	257.00	257.00
14	PRESSURE GAUGE WITH ISOLATION VALVE	1	NOS	85.00	85.00
15	PIPING (ERW SCH 40), INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	5,858.00	5,858.00
Total Price for the above:				14,460.00	

10 FIRE FIGHTING SYSTEM - SITE 2**BRAND: NAFFCO/SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	DOUBLE COMPARTMENT FIRE HOSE CABINET (EMPTY), RECESSED TYPE, COMPLETE 304 STANILESS STEEL BACK BOX, 304 STANILESS STEEL ARCHITRAVE & DOOR, BRUSH FINISH - NAFFCO	15	NOS	1,985.00	29,775.00
2	2 1/2" LANING VALVE W/ BUILT IN PRV	15	NOS	581.00	8,715.00
3	2 1/2" X 30 MTR. LONG FIRE HOSE C/W: 2 1/2" NOZZLE	15	NOS	601.00	9,015.00
4	CO2 FIRE EXTINGUISHER 5KG- KITEMARK	39	NOS	209.00	8,151.00
5	DRY POWDER EXTINGUISHER 6KG -KITEMARK	24	NOS	117.00	2,808.00
6	FOAM FIRE EXTINGUISHER 9LTR - KITEMARK	15	NOS	149.00	2,235.00
7	DOUBLE FIRE EXTINGUISHERS CABINET (EMPTY), RECESSED TYPE, COMPLETE 304 STANILESS STEEL BACK BOX, 304 STANILESS STEEL FRAME & DOOR, MIRROR FINISH (TO ACCOMMODATE 2 NO. PORTABLE TYPE EXTINGUISHER)- NAFFCO	24	NOS	1,215.00	29,160.00
8	8" OS & GATE VALVE WITH TAMPER SWITCH	1	NOS	2,137.00	2,137.00
9	BUTTERFLY VALVE 8"	10	NOS	1,125.00	11,250.00
10	AIR RELEASE VALVE 1"	6	NOS	257.00	1,542.00
11	PRESSURE GAUGE WITH ISOLATION VALVE	6	NOS	85.00	510.00
12	DRAIN VALVE 2"	4	NOS	667.00	2,668.00
13	PIPING (ERW SCH 40), INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	1,366,082.00	1,366,082.00

Total Price for the above: 1,474,048.00

11 FIRE FIGHTING SYSTEM -HANGAR AREA - SITE 2<<<TOTAL OF 2 AREAS>>>

BRAND: NAFFCO/SIELD

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	EMPTY DOUBLE COMPARTMENT FIRE CABINET, RECESSED TYPE, MILD STEEL BACK BOX, STAINLESS STEEL ARCHITRAVE & DOOR - NAFFCO	1	NOS	1,188.00	1,188.00
2	FIRE HOSE REEL 1" X 30 MTR. LONG, AUTOMATIC C/W: 1" INLET VALVE & 1" JET/SPRAY/SHUT NOZZLE - KITEMARK	1	NOS	536.00	536.00
3	LOCK SHIELD VALVE 1"	1	NOS	41.00	41.00
4	PRESSURE REDUCING VALVE 1"	1	NOS	115.00	115.00
5	2 1/2" LANDING VALVE W/ BUILT IN PRV	1	NOS	581.00	581.00
6	FIRE HOSE 2 1/2" X 30 MTRS C/W: 2 1/2" NOZZLE	1	NOS	601.00	601.00
7	CO2 FIRE EXTINGUISHER 5KG - KITEMARK	4	NOS	209.00	836.00
8	DRY POWDER EXTINGUISHER 6KG -KITEMARK	4	NOS	117.00	468.00
9	BREECHING INLET 6" X 4 WAY - KITEMARK	1	NOS	855.00	855.00
10	BREECHING INLET CABINET, SURFACE TYPE, COMPLETE STAINLESS STEEL BACK BOX, FRAME & DOOR WITH WIRED GLASS FRONT	1	NOS	932.00	932.00
11	NON RETURN VALVE 6"	1	NOS	1,229.00	1,229.00
12	OS & Y GATE VALVE 3" WITH TAMPER SWITCH	1	NOS	878.00	878.00
13	AIR RELEASE VALVE 1"	1	NOS	257.00	257.00
14	PRESSURE GAUGE WITH ISOLATION VALVE	1	NOS	85.00	85.00
15	PIPING (ERW SCH 40), INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	8,977.00	8,977.00
16	ADDITIONAL PRICE FOR ONE MORE AREA, SAME AS ABOVE	1	LS	17,579.00	17,579.00

Total Price for the above: 35,158.00

12 FIRE EXTINGUISHERS - SERVICE BUILDING - SITE 1 (GF)**BRAND: NAFFCO/SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	CO2 FIRE EXTINGUISHER 5KG - KITEMARK	9	NOS	209.00	1,881.00
2	DRY POWDER EXTINGUISHER 6KG -KITEMARK	9	NOS	117.00	1,053.00
3	DRY POWDER EXTINGUISHER 25KG - TROLLY - KITEMARK	1	NOS	743.00	743.00
4	CO2 FIRE EXTINGUISHER 30KG - TROLLY - KITEMARK	1	NOS	1,283.00	1,283.00
5	FOAM FIRE EXTINGUISHER 50LTR - TROLLY - KITEMARK	1	NOS	1,269.00	1,269.00
Total Price for the above:				6,229.00	

13 FIRE EXTINGUISHERS - SERVICE BUILDING(2A)-SITE 2 (B+GF)**BRAND: NAFFCO/SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	CO2 FIRE EXTINGUISHER 5KG - KITEMARK	10	NOS	209.00	2,090.00
2	DRY POWDER EXTINGUISHER 6KG -KITEMARK	10	NOS	117.00	1,170.00
3	DRY POWDER EXTINGUISHER 25KG - TROLLY - KITEMARK	2	NOS	743.00	1,486.00
4	CO2 FIRE EXTINGUISHER 30KG - TROLLY - KITEMARK	1	NOS	1,283.00	1,283.00
5	FOAM FIRE EXTINGUISHER 50LTR - TROLLY - KITEMARK	1	NOS	1,269.00	1,269.00
Total Price for the above:				7,298.00	

14 FIRE EXTINGUISHERS - SERVICE BUILDING(2B) - SITE 2 (GF)**BRAND: NAFFCO/SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	CO2 FIRE EXTINGUISHER 5KG - KITEMARK	2	NOS	209.00	418.00
2	DRY POWDER EXTINGUISHER 6KG -KITEMARK	2	NOS	117.00	234.00
Total Price for the above:					652.00

15 DELUGE SUPPRESSION SYSTEM - SITE 1**BRAND: SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	OPEN TYPE SPRINKLER HEAD 1" THREAD, PENDENT, BRASS, FLOW: 475-675 LPM, K- FACTOR 21.3, UL LISTED, MODEL: SD-4030PS - SHIELD	352	NOS		
2	DELUGE VALVE 4" C/W: BASIC TRIM, WET PILOT TRIM, 24 VDC SOLENOID VALVE, WATER MOTOR ALARM GONG, PRESSURE SWITCH, ETC.	88	SET		
3	MANUAL PULL STATION	88	NOS		
4	BUTTERFLY VALVE 4"	88	NOS		
5	BUTTERFLY VALVE 8"	16	NOS		
6	AIR RELEASE VALVE 1"	16	NOS		
7	DRAIN VALVE 2"	4	NOS		
8	PRESSURE GAUGE WITH ISOLATION VALVE	16	NOS		
9	8" OS & GATE VALVE WITH TAMPER SWITCH	1	NOS		
10	EXTINGUISHING CONTROL PANEL - ADDRESSABLE - CHEETAH XI	2	NOS		

15 DELUGE SUPPRESSION SYSTEM - SITE 1

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
11	NETWORK MODULE	2	NOS		
12	ADD RELEASING CONTROL MODULE	88	NOS		
13	POWER SUPPLY UNIT	8	NOS		
14	PIPING(ERW SCH 40/HDPE), INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		
Total Price for the above:					1,089,386.00

16 DELUGE SUPPRESSION SYSTEM - SITE 2**BRAND: SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	OPEN TYPE SPRINKLER HEAD 1" THREAD, PENDENT, BRASS, FLOW: 475-675 LPM, K- FACTOR 21.3, UL LISTED, MODEL: SD-4030PS - SHIELD	165	NOS		
2	DELUGE VALVE 4" C/W: BASIC TRIM, WET PILOT TRIM, 24 VDC SOLENOID VALVE, WATER MOTOR ALARM GONG, PRESSURE SWITCH, ETC.	42	SET		
3	MANUAL PULL STATION	42	NOS		
4	BUTTERFLY VALVE 4"	42	NOS		
5	BUTTERFLY VALVE 8"	10	NOS		
6	AIR RELEASE VALVE 1"	6	NOS		
7	PRESSURE GAUGE WITH ISOLATION VALVE	6	NOS		
8	DRAIN VALVE 2"	4	NOS		
9	PRESSURE GAUGE	6	NOS		

16 DELUGE SUPPRESSION SYSTEM - SITE 2

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
10	8" OS & GATE VALVE WITH TAMPER SWITCH	1	NOS		
11	EXTINGUISHING CONTROL PANEL - ADDRESSABLE - CHEETAH XI	1	NOS		
12	ADD RELEASING CONTROL MODULE	42	NOS		
13	POWER SUPPLY UNIT	4	NOS		
14	PIPING(ERW SCH 40/HDPE), INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		
Total Price for the above:					477,183.00

17 FM-200 FIRE SUPPRESSION SYSTEM - MV ROOM @ GF TUNNEL SERVICE BUILDING (SITE 1) - VOLUME 171 M3**BRAND - FIKE**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	375 LBS. HFC 227EA AGENT CYLINDER C/W: DISCHARGE VALVE, NIPPLE, VICTAULIC COUPLING, MOUNTING STRAP	1	SET		
2	FM-200 GAS	218	LBS		
3	IMPULSE VALVE ASSEMBLY	1	SET		
4	LOW PRESSURE SWITCH	1	NOS		
5	DISCHARGE PRESSURE SWITCH	1	NOS		
6	DISCHARGE NOZZLE	2	NOS		
7	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO	1	SET		
8	WEATHERPROOF ENCLOSURE FOR EXTINGUISHER PANEL	1	NOS		

**17 FM-200 FIRE SUPPRESSION SYSTEM - MV ROOM @ GF TUNNEL
SERVICE BUILDING (SITE 1) - VOLUME 171 M3**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
9	OPTICAL SMOKE DETECTOR W/ BASE	2	NOS		
10	MANUAL RELEASE W/BACK BOX	1	NOS		
11	ABORT SWITCH W/BACK BOX	1	NOS		
12	6" BELL WITH BACK BOX	1	NOS		
13	WEATHER PROOF STROBE HORN WITH BACK BOX	1	NOS		
14	WEATHER PROOF STROBE LIGHT WITH BACK BOX	1	NOS		
15	WARNING SIGN	2	NOS		
16	DISCONNECT SWITCH WITH LED	1	NOS		
17	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		
Total Price for the above:					50,371.00

NOTE:-

INTERFACING OF THE EXTINGUISHING PANEL WITH ANY OTHER SYSTEM ARE NOT CONSIDERED IN OUR OFFER.

**18 FM-200 FIRE SUPPRESSION SYSTEM - LV ROOM @ GF TUNNEL
SERVICE BUILDING (SITE 1) - VOLUME 1001 M3**

BRAND - FIKE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	1000 LBS. HFC 227 AGENT CYLINDER C/W: DISCHARGE VALVE, NIPPLE, VICTAULIC COUPLING, MOUNTING STRAP	2	SET		

**18 FM-200 FIRE SUPPRESSION SYSTEM - LV ROOM @ GF TUNNEL
SERVICE BUILDING (SITE 1) - VOLUME 1001 M3**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
2	FM-200 GAS	1251	LBS		
3	IMPULSE VALVE ASSEMBLY	2	SET		
4	MANUAL ACTUATOR	2	NOS		
5	LOW PRESSURE SWITCH	2	NOS		
6	DISCHARGE PRESSURE SWITCH	1	NOS		
7	NON RETURN VALVE (HI FLOW) - CHECK VALVE 3"	2	NOS		
8	MANIFOLD FOR 2 CYLINDERS	1	NOS		
9	DISCHARGE NOZZLE	7	NOS		
10	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO	1	SET		
11	WEATHERPROOF ENCLOSURE FOR EXTINGUISHER PANEL	1	NOS		
12	OPTICAL SMOKE DETECTOR W/ BASE	8	NOS		
13	MANUAL RELEASE W/BACK BOX	1	NOS		
14	ABORT SWITCH W/BACK BOX	1	NOS		
15	6" BELL WITH BACK BOX	1	NOS		
16	STROBE HORN WITH BACK BOX	1	NOS		
17	STROBE LIGHT WITH BACK BOX	1	NOS		
18	WEATHER PROOF STROBE HORN WITH BACK BOX	1	NOS		
19	WEATHER PROOF STROBE LIGHT WITH BACK BOX	1	NOS		
20	WARNING SIGN	4	NOS		
21	DISCONNECT SWITCH WITH LED	1	NOS		
22	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		

Total Price for the above:

182,183.00

**19 FM-200 FIRE SUPPRESSION SYSTEM - BATTERY ROOM @ GF
TUNNEL SERVICE BUILDING (SITE 1)- VOLUME 116 M3**

BRAND - FIKE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
1	215 LBS. HFC 227 AGENT CYLINDER C/W: DISCHARGE VALVE, NIPPLE, VICTAULIC COUPLING, MOUNTING STRAP	1	SET		
2	FM-200 GAS	150	LBS		
3	IMPULSE VALVE ASSEMBLY	1	SET		
4	LOW PRESSURE SWITCH	1	NOS		
5	DISCHARGE PRESSURE SWITCH	1	NOS		
6	DISCHARGE NOZZLE	1	NOS		
7	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO	1	SET		
8	WEATHERPROOF ENCLOSURE FOR EXTINGUISHER PANEL	1	NOS		
9	OPTICAL SMOKE DETECTOR W/ BASE	2	NOS		
10	MANUAL RELEASE W/BACK BOX	1	NOS		
11	ABORT SWITCH W/BACK BOX	1	NOS		
12	6" BELL WITH BACK BOX	1	NOS		
13	STROBE HORN WITH BACK BOX	1	NOS		
14	STROBE LIGHT WITH BACK BOX	1	NOS		
15	WEATHER PROOF STROBE HORN WITH BACK BOX	1	NOS		
16	WEATHER PROOF STROBE LIGHT WITH BACK BOX	1	NOS		
17	WARNING SIGN	4	NOS		
18	DISCONNECT SWITCH WITH LED	1	NOS		
19	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		

Total Price for the above:

45,289.00

**20 FM-200 FIRE SUPPRESSION SYSTEM - ELV/COMM ROOM @ GF
TUNNEL SERVICE BUILDING (SITE 1)- VOLUME 303 M3**

BRAND - FIKE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
1	650 LBS. HFC 227 AGENT CYLINDER C/W: DISCHARGE VALVE, NIPPLE, VICTAULIC COUPLING, MOUNTING STRAP		1 SET		
2	FM-200 GAS		382 LBS		
3	IMPULSE VALVE ASSEMBLY		1 SET		
4	LOW PRESSURE SWITCH		1 NOS		
5	DISCHARGE PRESSURE SWITCH		1 NOS		
6	DISCHARGE NOZZLE		2 NOS		
7	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO		1 SET		
8	WEATHERPROOF ENCLOSURE FOR EXTINGUISHER PANEL		1 NOS		
9	OPTICAL SMOKE DETECTOR W/ BASE		2 NOS		
10	MANUAL RELEASE W/BACK BOX		1 NOS		
11	ABORT SWITCH W/BACK BOX		1 NOS		
12	6" BELL WITH BACK BOX		1 NOS		
13	WEATHER PROOF STROBE HORN WITH BACK BOX		1 NOS		
14	WEATHER PROOF STROBE LIGHT WITH BACK BOX		1 NOS		
15	WARNING SIGN		4 NOS		
16	DISCONNECT SWITCH WITH LED		1 NOS		
17	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES		1 LOT		

Total Price for the above: 65,752.00

**21 FM-200 FIRE SUPPRESSION SYSTEM - MV ROOM @ GF TUNNEL
SERVICE BUILDING (SITE 2) - VOLUME 165 M3**

BRAND - FIKE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
1	375 LBS. HFC 227EA AGENT CYLINDER C/W: DISCHARGE VALVE, NIPPLE, VICTAULIC COUPLING, MOUNTING STRAP	1	SET		
2	FM-200 GAS	211	LBS		
3	IMPULSE VALVE ASSEMBLY	1	SET		
4	LOW PRESSURE SWITCH	1	NOS		
5	DISCHARGE PRESSURE SWITCH	1	NOS		
6	DISCHARGE NOZZLE	1	NOS		
7	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO	1	SET		
8	WEATHERPROOF ENCLOSURE FOR EXTINGUISHER PANEL	1	NOS		
9	OPTICAL SMOKE DETECTOR W/ BASE	2	NOS		
10	MANUAL RELEASE W/BACK BOX	1	NOS		
11	ABORT SWITCH W/BACK BOX	1	NOS		
12	6" BELL WITH BACK BOX	1	NOS		
13	WEATHER PROOF STROBE HORN WITH BACK BOX	1	NOS		
14	WEATHER PROOF STROBE LIGHT WITH BACK BOX	1	NOS		
15	WARNING SIGN	2	NOS		
16	DISCONNECT SWITCH WITH LED	1	NOS		
17	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		

Total Price for the above: 49,596.00

**22 FM-200 FIRE SUPPRESSION SYSTEM - LV ROOM @ GF TUNNEL
SERVICE BUILDING (SITE 2) - VOLUME 814 M3**

BRAND - FIKE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
1	650 LBS. HFC 227 AGENT CYLINDER C/W: DISCHARGE VALVE, NIPPLE, VICTAULIC COUPLING, MOUNTING STRAP	2	SET		
2	FM-200 GAS	1019	LBS		
3	IMPULSE VALVE ASSEMBLY	2	SET		
4	MANUAL ACTUATOR	2	NOS		
5	LOW PRESSURE SWITCH	2	NOS		
6	DISCHARGE PRESSURE SWITCH	1	NOS		
7	NON RETURN VALVE (HI FLOW) - CHECK VALVE 3"	2	NOS		
8	MANIFOLD FOR 2 CYLINDERS	1	NOS		
9	DISCHARGE NOZZLE	5	NOS		
10	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO	1	SET		
11	WEATHERPROOF ENCLOSURE FOR EXTINGUISHER PANEL	1	NOS		
12	OPTICAL SMOKE DETECTOR W/ BASE	8	NOS		
13	MANUAL RELEASE W/BACK BOX	1	NOS		
14	ABORT SWITCH W/BACK BOX	1	NOS		
15	6" BELL WITH BACK BOX	1	NOS		
16	WEATHER PROOF STROBE HORN WITH BACK BOX	1	NOS		
17	WEATHER PROOF STROBE LIGHT WITH BACK BOX	1	NOS		
18	WARNING SIGN	2	NOS		
19	DISCONNECT SWITCH WITH LED	1	NOS		
20	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		

**22 FM-200 FIRE SUPPRESSION SYSTEM - LV ROOM @ GF TUNNEL
SERVICE BUILDING (SITE 2)- VOLUME 814 M3**

Total Price for the above: 142,453.00

**23 FM-200 FIRE SUPPRESSION SYSTEM - ELV/COMM ROOM @ GF
TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 380 M3**

BRAND - FIKE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
1	650 LBS. HFC 227 AGENT CYLINDER C/W: DISCHARGE VALVE, NIPPLE, VICTAULIC COUPLING, MOUNTING STRAP		1 SET		
2	FM-200 GAS		478 LBS		
3	IMPULSE VALVE ASSEMBLY		1 SET		
4	LOW PRESSURE SWITCH		1 NOS		
5	DISCHARGE PRESSURE SWITCH		1 NOS		
6	DISCHARGE NOZZLE		2 NOS		
7	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO		1 SET		
8	WEATHERPROOF ENCLOSURE FOR EXTINGUISHER PANEL		1 NOS		
9	OPTICAL SMOKE DETECTOR W/ BASE		4 NOS		
10	MANUAL RELEASE W/BACK BOX		1 NOS		
11	ABORT SWITCH W/BACK BOX		1 NOS		
12	6" BELL WITH BACK BOX		1 NOS		
13	WEATHER PROOF STROBE HORN WITH BACK BOX		1 NOS		
14	WEATHER PROOF STROBE LIGHT WITH BACK BOX		1 NOS		

**23 FM-200 FIRE SUPPRESSION SYSTEM - ELV/COMM ROOM @ GF
TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 380 M3**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
15	WARNING SIGN	2	NOS		
16	DISCONNECT SWITCH WITH LED	1	NOS		
17	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		
Total Price for the above:					70,430.00

**24 FM-200 FIRE SUPPRESSION SYSTEM - BATTERY ROOM @ GF
TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 132 M3**

BRAND - FIKE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	215 LBS. HFC 227 AGENT CYLINDER C/W: DISCHARGE VALVE, NIPPLE, VICTAULIC COUPLING, MOUNTING STRAP	1	SET		
2	FM-200 GAS	170	LBS		
3	IMPULSE VALVE ASSEMBLY	1	SET		
4	LOW PRESSURE SWITCH	1	NOS		
5	DISCHARGE PRESSURE SWITCH	1	NOS		
6	DISCHARGE NOZZLE	1	NOS		
7	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO	1	SET		
8	WEATHERPROOF ENCLOSURE FOR EXTINGUISHER PANEL	1	NOS		
9	OPTICAL SMOKE DETECTOR W/ BASE	2	NOS		

**24 FM-200 FIRE SUPPRESSION SYSTEM - BATTERY ROOM @ GF
TUNNEL SERVICE BUILDING (SITE 2)- VOLUME 132 M3**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
10	MANUAL RELEASE W/BACK BOX	1	NOS		
11	ABORT SWITCH W/BACK BOX	1	NOS		
12	6" BELL WITH BACK BOX	1	NOS		
13	WEATHER PROOF STROBE HORN WITH BACK BOX	1	NOS		
14	WEATHER PROOF STROBE LIGHT WITH BACK BOX	1	NOS		
15	WARNING SIGN	4	NOS		
16	DISCONNECT SWITCH WITH LED	1	NOS		
17	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		
Total Price for the above:					45,819.00

**25 FM-200 FIRE SUPPRESSION SYSTEM - ELEC ROOM @ GF TUNNEL
SERVICE BUILDING (SITE 2)- VOLUME 259 M3**

BRAND - FIKE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	375 LBS. HFC 227EA AGENT CYLINDER C/W: DISCHARGE VALVE, NIPPLE, VICTAULIC COUPLING, MOUNTING STRAP	1	SET		
2	FM-200 GAS	328	LBS		
3	IMPULSE VALVE ASSEMBLY	1	SET		
4	LOW PRESSURE SWITCH	1	NOS		

**25 FM-200 FIRE SUPPRESSION SYSTEM - ELEC ROOM @ GF TUNNEL
SERVICE BUILDING (SITE 2)- VOLUME 259 M3**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
5	DISCHARGE PRESSURE SWITCH	1	NOS		
6	DISCHARGE NOZZLE	2	NOS		
7	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO	1	SET		
8	WEATHERPROOF ENCLOSURE FOR EXTINGUISHER PANEL	1	NOS		
9	OPTICAL SMOKE DETECTOR W/ BASE	2	NOS		
10	MANUAL RELEASE W/BACK BOX	1	NOS		
11	ABORT SWITCH W/BACK BOX	1	NOS		
12	6" BELL WITH BACK BOX	1	NOS		
13	WEATHER PROOF STROBE HORN WITH BACK BOX	1	NOS		
14	WEATHER PROOF STROBE LIGHT WITH BACK BOX	1	NOS		
15	WARNING SIGN	2	NOS		
16	DISCONNECT SWITCH WITH LED	1	NOS		
17	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		
Total Price for the above:				55,761.00	

**26 FOAM SYSTEM - GENERATOR ROOM @ GF TUNNEL SERVICE
BUILDING (SITE 1)- VOLUME 99 M3**

BRAND: NAFFCO, UAE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)

**26 FOAM SYSTEM - GENERATOR ROOM @ GF TUNNEL SERVICE
BUILDING (SITE 1) - VOLUME 99 M3**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
1	FOAM BLADDER TANK (VERTICAL), CAPACITY - 100 GALLONS C/W: - CARBON STEEL TANK TO ASME- REINFORCED BUNA-N RUBBER BLADDER- ANC- FILL & DRAIN VALVES- GLASS SIGHT TUBE. - NAFFCO UL LISTED	1	SET		
2	AFFF CONCENTRATE 3%	67	GAL		
3	DELUGE VALVE 3" C/W: BASIC TRIM, WET PILOT TRIM, 24 VDC SOLENOID VALVE, MANUAL RELEASE, WATER MOTOR ALARM GONG, PRESSURE SWITCH, ETC.	1	NOS		
4	OS & Y GATE VALVE 3" W/ TAMPER SWITCH	2	NOS		
5	AIR RELEASE VALVE 1" WITH ISOLATION COCK	1	NOS		
6	FOAM WATER SPRINKLER HEAD	12	NOS		
7	3" STRAINER	1	NOS		
8	GATE VALVE 3"	1	NOS		
9	PRV 3"	1	NOS		
10	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO	1	NOS		
11	WEATHERPROOF ENCLOSURE FOR THE PANEL	1	NOS		
12	HEAT DETECTOR W/ BASE	6	NOS		
13	FIRE ALARM BELL 6"	1	NOS		
14	STOBE LIGHT W/ BACK BOX W/P	1	NOS		
15	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		

Total Price for the above: 72,898.00

**27 FOAM SYSTEM - GENERATOR ROOM @ GF TUNNEL SERVICE
BUILDING (SITE 2) - VOLUME 142 M3**

BRAND: NAFFCO, UAE

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
1	FOAM BLADDER TANK (VERTICAL), CAPACITY - 100 GALLONS C/W: - CARBON STEEL TANK TO ASME- REINFORCED BUNA-N RUBBER BLADDER- ANC- FILL & DRAIN VALVES- GLASS SIGHT TUBE. - NAFFCO UL LISTED	1	SET		
2	AFFF CONCENTRATE 3%	97	GAL		
3	DELUGE VALVE 3" C/W: BASIC TRIM, WET PILOT TRIM, 24 VDC SOLENOID VALVE, MANUAL RELEASE, WATER MOTOR ALARM GONG, PRESSURE SWITCH, ETC.	1	NOS		
4	OS & Y GATE VALVE 3" W/ TAMPER SWITCH	2	NOS		
5	AIR RELEASE VALVE 1" WITH ISOLATION COCK	1	NOS		
6	FOAM WATER SPRINKLER HEAD	12	NOS		
7	3" STRAINER	1	NOS		
8	GATE VALVE 3"	1	NOS		
9	PRV 3"	1	NOS		
10	EXTINGUISHING CONTROL PANEL, CONVENTIONAL - SHP PRO	1	NOS		
11	WEATHERPROOF ENCLOSURE FOR THE PANEL	1	NOS		
12	HEAT DETECTOR W/ BASE	6	NOS		
13	FIRE ALARM BELL 6"	1	NOS		
14	STOBE LIGHT W/ BACK BOX W/P	1	NOS		
15	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		

Total Price for the above: 73,828.00

**28 HIGH VELOCITY SPRAY SYSTEM - TRANSFORMER ROOM @ GF
TUNNEL SERVICE BLOCK - SITE 1**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
1	WATER SPRAY NOZZLE HIGH VELOCITY - END CONNECTION= 3/4" NPT, CHROME PLATED BRONZE , K-FACTOR =23, SPRAY ANGLE - 120 DEG.	32	NOS		
2	DELUGE VALVE ASSEMBLY 3" DIA C/W : BASIC TRIM , ELECTRIC TRIM ,24 V DC SOLENOID MANUAL RELEASE , WATER METER ALARM GONG , PRESSURE SWITCH , MAIN DRAIN VALVE , PRESSURE GAUGE .	1	SET		
3	OS & Y GATE VALVE 3" W/TAMPER SWITCH	2	NOS		
4	Y TYPE STRAINER 3"	1	NOS		
5	OS & Y GATE VALVE 3"	1	NOS		
6	EXTINGUISHING CONTROL PANEL - CONVENTIONAL - SHP PRO	1	NOS		
7	HEAT DETECTOR W/ BASE	4	NOS		
8	FIRE ALARM BELL 6" W/ BACK BOX	1	NOS		
9	STROBE LIGHT W/ BACK BOX W/P	1	NOS		
10	WEATHERPROOF ENCLOSURE FOR PANEL	1	NOS		
11	PRV 3"	1	NOS		
12	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		
Total Price for the above:					38,129.00

**29 HIGH VELOCITY SPRAY SYSTEM - TRANSFORMER ROOM @ GF
TUNNEL SERVICE BLOCK - SITE 2**

**29 HIGH VELOCITY SPRAY SYSTEM - TRANSFORMER ROOM @ GF
TUNNEL SERVICE BLOCK - SITE 2**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
		(in Aed)			
1	WATER SPRAY NOZZLE HIGH VELOCITY - END CONNECTION= 3/4" NPT, CHROME PLATED BRONZE , K-FACTOR =23, SPRAY ANGLE - 120 DEG.	32	NOS		
2	DELUGE VALVE ASSEMBLY 3" DIA C/W : BASIC TRIM , ELECTRIC TRIM ,24 V DC SOLENOID MANUAL RELEASE , WATER METER ALARM GONG , PRESSURE SWITCH , MAIN DRAIN VALVE , PRESSURE GAUGE .	1	SET		
3	OS & Y GATE VALVE 3" W/TAMPER SWITCH	2	NOS		
4	Y TYPE STRAINER 3"	1	NOS		
5	OS & Y GATE VALVE 3"	1	NOS		
6	EXTINGUISHING CONTROL PANEL - CONVENTIONAL - SHP PRO	1	NOS		
7	HEAT DETECTOR W/ BASE	4	NOS		
8	FIRE ALARM BELL 6" W/ BACK BOX	1	NOS		
9	STROBE LIGHT W/ BACK BOX W/P	1	NOS		
10	WEATHERPROOF ENCLOSURE FOR PANEL	1	NOS		
11	PRV 3"	1	NOS		
12	PIPING, INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT		

Total Price for the above: 38,129.00

30 SPARE PARTS FOR PUMP SET

NAFFCO/SIELD

30 SPARE PARTS FOR PUMP SET

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	SPARE PARTS FOR PUMP SET		1 LOT		
Total Price for the above:					12,000.00

31 SPRINKLER SYSTEM - SPARE PARTS**BRAND: SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	UPRIGHT SPRINKLER HEAD, ½" ORIFICE X ½" NPT INLET, GLASS BULB TYPE, K-5.6, 79°C, BRASS FINISH, STD RESPONSE	6	NOS	12.00	72.00
2	SPRINKLER WRENCHES	1	NOS	225.00	225.00
3	SPRINKLER HEAD CABINET	1	NOS	375.00	375.00
Total Price for the above:					672.00

32 SPARE PARTS FOR FIRE FIGHTING SYSTEM

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	2 1/2" X 30 MTR. LONG FIRE HOSE C/W: 2 1/2" NOZZLE	5	NOS	601.00	3,005.00

32 SPARE PARTS FOR FIRE FIGHTING SYSTEM

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
2	INSTANTANEOUS COUPLING	5	NOS		
3	SPANNERS FOR HOSE COUPLINGS	5	NOS		
Total Price for the above:					5,035.00

33 SPARE PARTS FOR HIGH VELOCITY SPRAY SYSTEM**NAFFCO/SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	HIGH VELOCITY WATER SPRAY NOZZLE	53	SET		
Total Price for the above:					8,586.00

34 SPARE PARTS FOR FOAM SYSTEM

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Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	FOAM SPRINKLER HEAD	3	NOS		
2	HEAT DETECTOR W/BASE	2	NOS		
Total Price for the above:					881.00

35 SPARE PARTS FOR FM200 SYSTEM

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	DISCHARGE NOZZLE		3 NOS		
2	MANUAL RELEASE W/BACK BOX		1 NOS		
3	OPTICAL SMOKE DETECTOR W/ BASE		2 NOS		
4	STROBE HORN WITH BACK BOX		1 NOS		
5	STROBE LIGHT WITH BACK BOX		1 NOS		
6	FIRE ALARM BELL 6" W/BACK BOX		1 NOS		
Total Price for the above:				2,600.00	

36 FIRE FIGHTING SYSTEM - TUNNEL SERVICE BUILDING SITE - 1**BRAND: NAFFCO/SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	EMPTY DOUBLE COMPARTMENT FIRE CABINET, RECESSED TYPE, MILD STEEL BACK BOX, STAINLESS STEEL ARCHITRAVE & DOOR - NAFFCO		1 NOS	1,188.00	1,188.00
2	FIRE HOSE REEL 1" X 30 MTR. LONG, AUTOMATIC C/W: 1" INLET VALVE & 1" JET/SPRAY/SHUT NOZZLE - KITEMARK		1 NOS	536.00	536.00
3	LOCK SHIELD VALVE 1"		1 NOS	41.00	41.00
4	PRESSURE REDUCING VALVE 1"		1 NOS	115.00	115.00
5	2 1/2" LANDING VALVE W/ BUILT IN PRV		1 NOS	581.00	581.00
6	FIRE HOSE 2 1/2" X 30 MTRS C/W: 2 1/2" NOZZLE		1 NOS	601.00	601.00
7	CO2 FIRE EXTINGUISHER 5KG - KITEMARK		1 NOS	209.00	209.00

36 FIRE FIGHTING SYSTEM - TUNNEL SERVICE BUILDING SITE - 1

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
8	DRY POWDER EXTINGUISHER 6KG -KITEMARK	1	NOS	117.00	117.00
9	BREECHING INLET 6" X 4 WAY - KITEMARK	1	NOS	855.00	855.00
10	BREECHING INLET CABINET, SURFACE TYPE, COMPLETE STAINLESS STEEL BACK BOX, FRAME & DOOR WITH WIRED GLASS FRONT	1	NOS	932.00	932.00
11	NON RETURN VALVE 6"	1	NOS	1,229.00	1,229.00
12	OS & Y GATE VALVE 2 1/2" WITH TAMPER SWITCH	1	NOS	729.00	729.00
13	AIR RELEASE VALVE 1"	1	NOS	257.00	257.00
14	PRESSURE GAUGE WITH ISOLATION VALVE	1	NOS	85.00	85.00
15	PIPING (SEAMLESS SCH 40), INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	7,674.00	7,674.00
Total Price for the above:				15,149.00	

**37 FIRE FIGHTING SYSTEM - TUNNEL SERVICE BUILDING SITE - 2
[2A & 2B]****BRAND: NAFFCO/SHIELD**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	EMPTY DOUBLE COMPARTMENT FIRE CABINET, RECESSED TYPE, MILD STEEL BACK BOX, STAINLESS STEEL ARCHITRAVE & DOOR - NAFFCO	3	NOS	1,188.00	3,564.00
2	FIRE HOSE REEL 1" X 30 MTR. LONG, AUTOMATIC C/W: 1" INLET VALVE & 1" JET/SPRAY/SHUT NOZZLE - KITEMARK	3	NOS	536.00	1,608.00
3	LOCK SHIELD VALVE 1"	3	NOS	41.00	123.00

**37 FIRE FIGHTING SYSTEM - TUNNEL SERVICE BUILDING SITE - 2
[2A & 2B]**

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
4	PRESSURE REDUCING VALVE 1"	3	NOS	115.00	345.00
5	2 1/2" LANDING VALVE W/ BUILT IN PRV	3	NOS	581.00	1,743.00
6	FIRE HOSE 2 1/2" X 30 MTRS C/W: 2 1/2" NOZZLE	3	NOS	601.00	1,803.00
7	CO2 FIRE EXTINGUISHER 5KG - KITEMARK	3	NOS	209.00	627.00
8	DRY POWDER EXTINGUISHER 6KG -KITEMARK	3	NOS	117.00	351.00
9	BREECHING INLET 6" X 4 WAY - KITEMARK	1	NOS	855.00	855.00
10	BREECHING INLET CABINET, SURFACE TYPE, COMPLETE STAINLESS STEEL BACK BOX, FRAME & DOOR WITH WIRED GLASS FRONT	1	NOS	932.00	932.00
11	NON RETURN VALVE 6"	1	NOS	1,229.00	1,229.00
12	OS & Y GATE VALVE 4" WITH TAMPER SWITCH	1	NOS	918.00	918.00
13	AIR RELEASE VALVE 1"	1	NOS	257.00	257.00
14	PRESSURE GAUGE WITH ISOLATION VALVE	1	NOS	85.00	85.00
15	PIPING (SEAMLESS SCH 40), INSTALLATION, TESTING & COMMISSIONING CHARGES	1	LOT	9,404.00	9,404.00
Total Price for the above:					23,844.00

38 <<OPTIONAL OFFER>> SEISMIC

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Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
					(in Aed)
1	SEISMIC SUPPLY & INSTALLATION	1	LOT	390,000.00	390,000.00
Total Price for the above:					390,000.00

38 <<OPTIONAL OFFER>> SEISMIC

39 <<OPTIONAL OFFER>> GI & FLEXIBLE CONDUITS

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Sl.No.	Item Description	Qty	Unit	Unit Price		Total Price
						(in Aed)
1	GI & FLEXIBLE CONDUITS SUPPLY & INSTALLATION		1 LOT	682,500.00		682,500.00
		Total Price for the above:		682,500.00		

40 PUDDLE FLANGE & ANTI VORTEX PLATE

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Sl.No.	Item Description	Qty	Unit	Unit Price		Total Price
						(in Aed)
1	PUDDLE FLANGE & ANTI VORTEX PLATE FOR 2 PUMPSETS		1 LOT	26,000.00		26,000.00
		Total Price for the above:		26,000.00		

41 EXHAUST PIPING

41 EXHAUST PIPING

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Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
1	EXHAUST PIPING FOR 2 PUMPSETS	1	LOT	26,000.00	26,000.00
Total Price for the above:					26,000.00

42 * GI TRUNKS & SMOKE MANAGEMENT PANEL <<OPTIONAL OFFER>> *****

Sl.No.	Item Description	Qty	Unit	Unit Price	Total Price
				(in Aed)	
Total Price for the above:					

TERMS & CONDITIONS FOR SUPPLY AND INSTALLATION

TOTAL PRICE OF OFFER W/ OUT OPTIONAL (AFTER DISCOUNT) :
Dhs.6,500,000.00/-

METHOD OF PAYMENT : To be mutually agreed.

INSTALLATION & SUPERVISION : Included
[Pipes & Fittings used is UL Listed & ADCCD Approved in this Projected]
TESTING & COMMISSIONING : Included

DELIVERY & INSTALLATION : To be mutually agreed.

WARRANTY: As per NAFFCO standard warranty. One year from the date of Testing and Commissioning. Warranty covers only limited to changing or replacing defected parts free of charge and does not cover misuse or mishandling of equipment. Warranty does not cover damage to fire pump set due to dry run.

VALIDITY OF OFFER : 21 days from the date of offer.
This quotation is only valid for the total price and quantity stated in our offer.

Notes:-

- " We reserve the rights to correct prices in case of any typographic or arithmetic errors. Any additional works/items in deviation to our approved offer shall be considered as a variation with mutually agreed cost and time.
- " Any cancelation of LPO/materials after 2 weeks from Its Date, will be charged 30% upon cancelation in case materials are ready for delivery.
- " Delivery schedule to be confirmed after receiving LPO copy along with latest approved CD/ Consultant. against Drawings/ Materials

Note:- "The price stated herein shall be exclusive of any taxes imposed by the government and shall be charged separately"

Works/Items not included in our offer.

- A. Fire rated cable, cable tray and other accessories for connecting isolator to the fire pump controller
- B. Water tank accessories [puddle flange & anti vortex plate] and fire pump room.
- C. Sleeves and Fire Stops
- D. Electrical Power and water.
- E. All civil works i,e excavation, back filling, compacting, asphalting, sand and sand laying, concreting, holding etc.
- F. Provision of power supply adjacent to controller / FACP.

- G. Items not mentioned in our offer but required by the consultant or Civil Defence.
- H. Scaffolding , Conduits ,Seismic & Integration with Hassantuk.
- I. Site Office & AMC
- J. House of Experts/Civil Defence Fees.
- K. Civil Defence certificate will be signed only after receiving 95% of the contract value.
- L. If the site is out side of Abu Dhabi city then Food, Accommodation & Transportation to be provided from your side.
- M. Integrity Test.
- N. Cladding & Installation works for diesel engine driven pump exhaust pipe.
- O. Value Added Tax (VAT)

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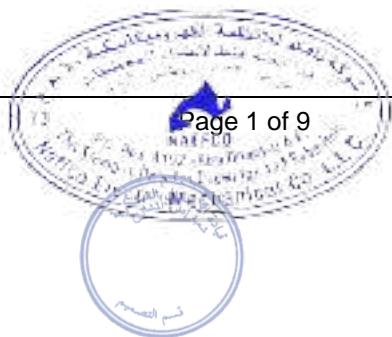
Section: 26 52 00 (Emergency Lighting)

SECTION 26 52 00

EMERGENCY LIGHTING

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Section: 26 52 00 (Emergency Lighting)

PART 1 - GENERAL

1.01 DESCRIPTION OF WORKS

- A. Supply, installation, testing, commissioning and maintenance during warranty period of the central battery emergency lighting system as specified hereafter, as indicated in the relevant electrical system drawing and to ENGINEER approval.
- B. Scope of work shall include but not limited to the following:
 1. All slave emergency and exit luminaries complete with all accessories.
 2. System components required to connect one lamp of all light fixtures selected for emergency lighting including light sensing module, address module etc
 3. Central monitoring computer system including system software, printer, interfacing modules and all related accessories in the control room.
- C. The Emergency lighting system and all its components shall be designed and installed to meet the local Civil Defence requirements and the respective DIN/VDE 0108 & BS5266 standards applicable to this project. The product shall be approved by local Civil Defence Authority.
- D. Emergency lighting shall fulfill the following functions:
 1. Illuminate the escape routes.
 2. Indicate the escape route direction clearly
 3. Provide Exit signs on all Exits
 4. Ensure fire alarm call points, fire fighting equipment and other life saving equipment on the premises are illuminated during Power failure period of time.
- E. The central battery panels shall be located at LV room and at each technical level in the electrical room with each panel appropriately designed to ensure that failure of one panel shall not result in total emergency lighting supply failure of the entire building.
- F. The emergency back up duration time shall be 3 hours with 100% light output of connected light fittings

1.02 STANDARDS

- A. Complete emergency lighting system shall be engineered and constructed in accordance with the latest revision of the following standards and the appropriate BS/IEC:
 1. All local Authority Regulations.
 2. British standards and its related code of practices
 3. British approvals service for Electric Cables (BASEC).
 4. The system shall be in compliance with all the requirements of European standards EN DIN50081 & will have EMC compatibility as per EN 550011, 61000 (3-2) (4-2) (4-4), ENV50140 & EN50141
 5. EN 60146 Series Semiconductor converters



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Section: 26 52 00 (Emergency Lighting)

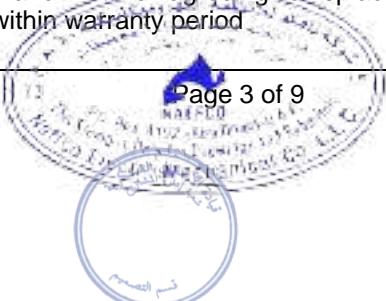
6. EN 60598-1 Luminaries-Part 1: General requirements and tests(IEC 598-1)
 7. EN 60598-2-22 Part-2 : Section 22: Luminaires for emergency lighting
 8. EN 60896-1 Stationary lead acid batteries-General requirements and method of test (IEC 896-1)
 9. EN 60529 Degree of protection provided by enclosures
 10. EN 50171 Central power supply systems
 11. BS 5266 Emergency lighting
 12. BS 5499 Fire safety signs, notices and graphic symbols
- B. The detail of the emergency lighting system shall also conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this Specification and Drawings, whichever is the more stringent and acceptable to the Engineer.
- C. In the adoption of standards and requirements, the Contractor shall take the following precedence:
1. Engineer's decision;
 2. Local codes of practice;
 3. Specification;
 4. Drawings;
 5. Internal standards and requirements

1.03 QUALITY CONTROL/ASSURANCE

- A. The Quality Control/Assurance duties shall be performed by the Contractor. The system of Quality Control/Assurance verification by the Contractor shall be in accordance with ISO 9000 standards of Quality Assurance.
- B. All products used in the emergency lighting system shall be manufactured by an ISO9011 certified company, complying with the relevant VDE/DIN/BS/EN standards and shall bear the CE certification for Electro-Magnetic compatibility. The product shall be field proven in the Middle East.

1.04 WARRANTY

- A. The Contractor shall warrant that all materials and equipment are suitable for continuous use and operation in the climatic conditions encountered on site.
- B. All equipment and materials shall be fully tropicalised and suitable for use in the peculiar local climate and operating conditions. All equipment/system shall be suitable for operation with outdoor dry bulb temperature of at least up to 50°C and relative humidity of up to 100%.
- C. Written warranty shall be provided, signed by manufacturer and installer agreeing to replace devices and equipment that fail in materials or workmanship within warranty period



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Section: 26 52 00 (Emergency Lighting)

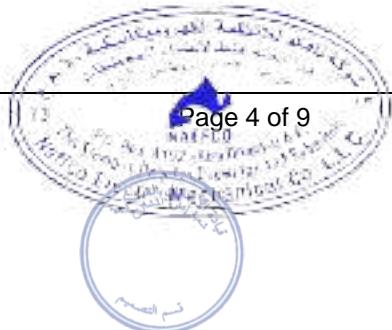
1.05 SUBMITTALS

- A. Sample Warranty: Copy of manufacturer's proposed warranty, stating obligations, remedies, limitations, and exclusions.
- B. Shop Drawings.
- C. Manufacturer's Installation Instructions.
- D. System Operations description: Include method of operation and supervision of each component and each type of circuit, and sequence of operations for manually and automatically initiated system inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are not acceptable.
- E. Product certificates: Signed by manufacturers of components certifying that products furnished comply with requirements.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects/engineers and owners, and other information specified or required by Engineer.
- G. Tests and Certificates: Submit complete certified manufacturer's types and routine test records, in accordance with the Standards specified in "Quality Assurance" Article.
- H. Field Test Reports: as specified in "Field Quality Control" Article of the specification section. Indicate and interpret test results for compliance with system description and performance requirements.
- I. Record (As-Built) Drawings: Include:
 - 1. Complete wiring diagrams, including complete terminal strip layout and identification, and wire termination and tagging for all conductors.
 - 2. Locations for all components installed and/or connected to under this specification.
 - 3. Number of sets and type of format required shall comply with contract documents.
- J. Warranties: Warranties specified in this Section.
- K. Certificate of Origin.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. General
 - 1. The central battery system and associated slave luminaires will cover the Emergency & Exit luminaires as detailed in the drawing and specifications. The Central Battery Panels will be of modular nature with plug-in-components for the ease of maintenance and reduced downtime.



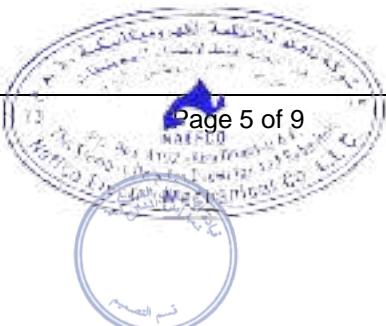
**CMW GENERAL SPECIFICATION
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Section: 26 52 00 (Emergency Lighting)

B. Modular Central Battery Panels

1. Each central emergency battery supply panels shall be used for supply, automatic testing and monitoring of maximum 20 no. Escape route, EXIT and safety luminaries in each circuit. Exact number of panels shall be determined as per the detailed design based on the CONSULTANT approved product. Panels shall be located inside electrical rooms and a trunking shall be provided inside electrical room as a riser to enable connection of panels located in different floors.
2. Each panel shall be fully independent and stand alone type.
 - a. Input Voltage : 220/240V AC
 - b. Output mains : 240V AC
 - c. Output Emergency : 240V DC
3. The battery backup required for the complete system is for a duration of three hours with 100% light output on connected fittings.
 - a. Mechanical Construction
4. Sheet steel powder coated housing to IP21. Separate compartment shall be provided for batteries. Panel should be suitable for wall mounting and panel door will have transparent window to view optical failure/status indication and shall be provided with printed diagram on the internal cover.
5. The electronic compartment shall have large cabling compartment with cable entries from top with four or more undrilled removable metal flange plates. All incoming cables and looping circuits shall be connected on protected and fused terminals as per ENVDE0100. All outgoing luminaires circuits shall be connected direct to relevant components via plug in type terminals.
 - a. Electrical Construction
 - 1) The system shall be of modular construction with all modules being plug in type encapsulated design. The outgoing circuits shall be fed through changeover modules. Each module shall be capable of switching two separate circuits with maximum load of 3 amps or 20 number light fixtures connected to it. Connection of luminaires of all switching modes shall be possible in each circuit. Change over modules shall have no load and short circuit protection with independent fuses for mains and battery supply and shall have status indication for operation and failure. Each panel shall have maintenance free sealed, lead acid batteries, with 10 years service life at 25 degree C, 120% capacity to manufacturer standard and with enough capacity to light up all connected lights for 3 hours duration with 100% light output on all connected luminaires and with sufficient nos. of converters forming 12 independent circuit suitable for connecting maximum 20 nos. of luminaire on each circuit. Where the space required for the batteries does not permit the installation of same in standard enclosure, it shall be installed in a separate cabinet similar to the central battery panel cabinet.
 - b. Battery Charger

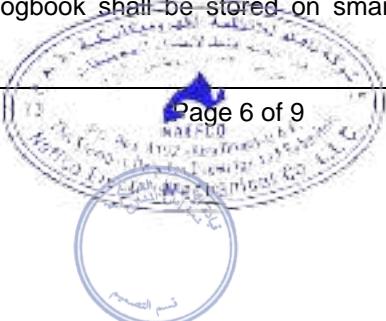


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- 1) The plug-in-type battery charger should be high efficiency temperature controlled charger, working to IU characteristics. It will have built in deep discharge protection for long Battery life. It will be suitable for fast recharging based on Battery status and time controlled trickle charging current. It will supervise the battery status such as low/high battery block voltage, failures within charging circuit and relay the faults to control module. The charger shall be designed for a 90% recharge of a fully discharged battery set within 20 hours. It shall be complete with the following:
 - a) Earth leakage monitoring
 - b) LED indication for 'operation', charger ON, Booster ON, Mains Operation, Battery capacity 10 %, 50%, 100% Charging failure, Insulation fault.
 - c) Push button to simulate earth leakage failures. Each panel shall be provided with a non-switched spur outlet next to the panel.
 - d) Sub-circuit Monitoring: An electronically regulated monitoring loop output shall be included to monitor the mains failure at distribution/sub-distribution board. The relevant distribution boards/sub-distribution board should be fitted with sub-circuit monitoring device. Individual power circuits monitoring devices and relays shall be installed in separate enclosure/DB to monitor individual circuits feeding to emergency/normal lights through lighting control system/local switches etc.
 - e) Control Module
 - f) Each panel will have plug-in-type freely programmable control module with two line liquid crystal display and constant memory back up and has the following main functions:
 - g) Monitor and control all test cycles and functions
 - h) Indicate every status of the system and the connected luminaire
 - i) Communicate and program the function of the addressable electronic ballast on every slave luminaire
 - j) Programming and status of the sub circuit monitoring inputs and the associated luminaires
 - k) Battery charge current.
 - l) It displays battery voltage level, battery charge current, required battery charging time/duration time withdrawn battery current in test or emergency modes, charge failures, interrupted battery charge circuit, luminaire failure with luminaire address, function test, battery test. Both tests can be manually programmed. The control module shall be linked to the central monitoring device installed at the control room and shall have three L.E.D.s for status indication of mains supply ON/OFF, luminaire or unit failure and battery supply.
 - m) Programming of the control module shall be possible through a smart card and all the information including the logbook shall be stored on smart card, which is readable on PC directly.



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C. Central Monitoring Device

1. The central monitoring computer, including all monitoring hardware and programming unit, the PC should have a graphical user interface software to give detailed address and information of all luminaire connected to the system. The program shall be user friendly with visually clear fault indication on the monitor. The computer shall be as per the latest state-of-art specification at the time of commissioning with laser coloured printer and 19" LCD monitor.

D. Slave Emergency Luminaire (Suitable for connection across central battery system).

1. All luminaires shall meet following requirements:
 - a. Supply voltage 220V/240V AC/DC
 - b. The luminaire shall comply the requirements of EN60594
 - c. Electronic ballast shall comply the requirements of EN60298/60294
 - d. EMC or EMI protection to EN55015
 - e. Ambient Temperature – 40°C

E. Plant Rooms

1. It will be non maintained type slave luminaire with 8 watt flurescent lamp with addressable low loss electronic ballast which can communicate with central control module. Luminaire housing shall be white plastic.

2. Protection class I, IP 65

F. False Ceiling areas (Non-Public Areas).

1. 1 x 8w fully recessed Emergency luminaire. Housing sheet steel white with electronic ballast and communication module.

G. Salve Exit luminaire (suitable for connection across central battery system)

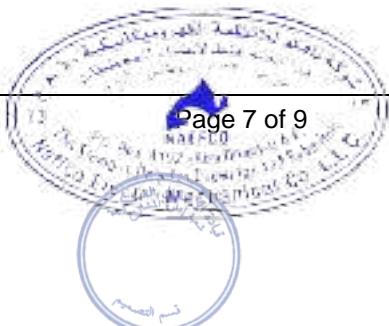
H. Ordinary Type (External)

1. Maintained 8w luminaire, wall mounted with addressable low loss electronic ballast which can communicate with the panel.
2. Protection : IP-65
3. Minimum viewing distance 30 meters
4. The diffuser will have EXIT legend with running man and directional arrow. Housing white plastic and diffuser.

I. Car Park

1. Same as ordinary type, but pendant type with escape symbol on both sides.

J. Fire Hose Reel (FHR)



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1. Same as car park type, but with fire hose reel signage.
- K. Decorative Exit luminaire type edge illuminated (Corridor)
 1. Exit light type shall be exclusive edge light with acrylic glass panel and pendant type. The housing will be slim aluminium housing white with snap on facility panels. It will have 8 w fl. Luminaire and addressable electronic ballast.
 2. The luminaire shall comply the requirements on EN60598
 3. Electronic ballast shall comply the requirements of EN60298/60294
 4. EMC or EMI protection to EN55015
- L. Internal Areas and Main Entrance
 1. Maintained 8w, wall mounted luminaire extremely flat housing with Arc shaped design. Housing aluminium plastic opal diffuser with 'Running Man' sticker.
- M. Sample of all luminaires proposed to use in the project shall be forwarded for prior approval.
 1. All low voltage 50w halogen lamp luminaire must be supplied with electronic transformers suitable for 240V AC/DC operation and dimming. Each halogen lamp luminaire to be provided with address module.
- N. High Frequency Electronic Control Gear
 1. All safety luminaries to be connected to the central emergency battery system shall be with high frequency electronic control gear.
 2. The high frequency electronic ballast shall be with monitoring facility, easy accessible address module, and shall have an automatic cut out fuse for failures within lamp circuit.
 3. It shall be built to EN 60298/60294 and EN 60924/60925.
 4. EMC protection shall be to EN 55015.
- O. System Wiring
 1. Wiring for central emergency system shall be carried out using fire resistant cable complying with BS 6387 catalogue CWZ.

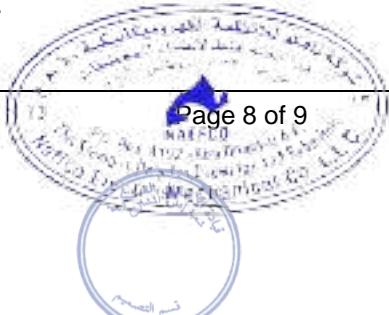
PART 3 - EXECUTION

3.01 INSTALLATION

- A. The emergency light shall be connected such that in case of power failure in any of the area, the emergency light installed in that area shall be energized.
- B. Wiring of the emergency light shall be carried out using fire resistant FP 200 Cable.

3.02 TESTING AND COMMISSIONING

- A. The Contractor shall be responsible for testing and commissioning of the installation in accordance with all applicable documents in the Contract set.



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Section: 26 52 00 (Emergency Lighting)

1. Testing shall be comprehensive and sufficient to demonstrate compliance with each requirement and as per system manufacturer recommendations.
2. A proposed test plan shall be submitted to the CONSULTANT or Owner's representative for approval before commencement of final test.
3. Final tests shall be conducted in the presence of the CONSULTANT or Owner's representative.

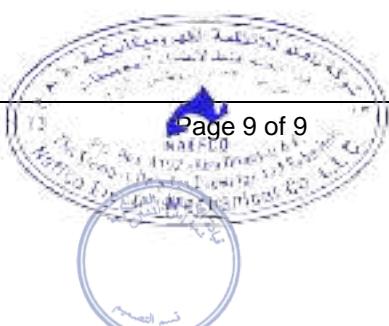
3.03 TRAINING AND INSTRUCTION

- A. Operator training shall consist of a two days course conducted on-site by a factory trained professional instructor. Training conducted by installers, technicians, or project managers is unacceptable.
- B. Training materials shall consist of the following:
 1. Formal course outline and agenda.
 2. Operator training student guide for each student.
 3. Hands-on practice with on-line equipment.
 4. Written examinations.
- C. The training course shall be a minimum of two contiguous business days.
- D. Additional equipment Video Imaging training sessions shall be made available to the Owner if necessary, at no additional cost.

3.04 WARRANTY

- A. All equipment furnished under this contract shall be warranted for a period of twelve (12) months from the date of final Owner acceptance of the system.
 1. Respond to service requests on-site, if required.
 2. Replace or repair defective components as required.

END OF SECTION



**CMW GENERAL SPECIFICATION
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Section: 28 31 00 (Fire Detection And Alarm System)

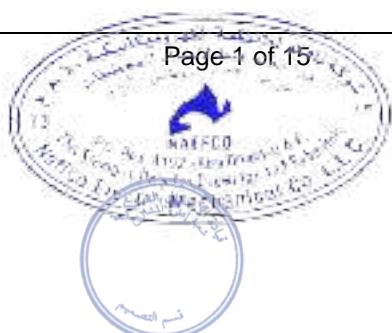


SECTION 28 31 00

FIRE DETECTION AND ALARM SYSTEM

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Section: 28 31 00 (Fire Detection And Alarm System)

PART 1 - GENERAL

1.01 WORK DESCRIPTION

- A. The scope of works shall includes supply, installation, testing, commissioning and maintenance during guarantee period of analogue addressable fire alarm system as specified herein and as indicated in the related drawings. The system shall consist of but not limited to the following:
 - B. Stand alone Analogue addressable fire alarm control panels, fire alarm repeater panels/LCD annunciators, Voice evacuation panels, photo electric smoke detectors, heat detectors, duct mounted detectors, line isolators, various addressable interfacing modules, manual break glass call units, fire alarm bells/sounders, voice evacuation speakers, bells with strobe light, fire fighters, power supplies, etc.
 - C. Stand alone fire alarm control panel of each building shall also be interfaced to the Central control center/main fire alarm control panel of the Military Works Complex.
 - D. The work covered by this section of the specifications includes the furnishing of all labour, equipment, materials, and performances of all operations in connection with the installation of the Fire Alarm system as shown on the drawings and as herein specified for the related items.
 - E. The complete installation is to conform to the applicable sections of NFPA-72, NFPA71, Local Code Requirements and National Electrical Code with particular attention to Article 760.
 - F. The work covered by this section of the specifications is to be coordinated with the related work as specified elsewhere under the project specifications.

1.02 QUALITY ASSURANCE

- A. Items of the fire Alarm system shall be listed as a product manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment is to be listed under UL category UOJZ as a single control unit.
- B. The equipment and installation supervision furnished under this specification is to be provided by a representative or by a certified distributor of the manufacturer, who has been engaged in production of this type software driven equipment for at least ten (10) years and has an authorized representative in UAE.
- C. Design, manufacture, testing and method of installation of all apparatus and materials furnished under requirement of these specification shall conform to latest publications or standard rules of the following:
 1. UAE FIRE AND LIFE SAFETY CODE OF PRACTICE.

1.03 CODES AND STANDARDS

- A. All equipment proposed and planned for use must have proper listing and/or approval from the nationally recognized agencies listed below:



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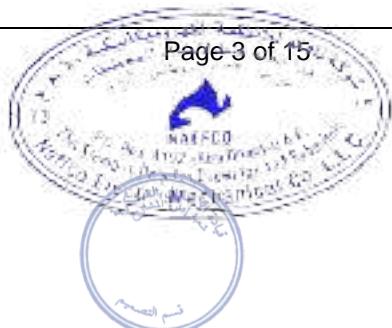


Section: 28 31 00 (Fire Detection And Alarm System)

1. UL Underwriters Laboratories
2. FM Factory Mutual
3. FOC Fire Officers Committee
4. LPCB Loss Prevention Certification Board
5. NFPA 70, 71 AND 72
6. National Electrical Code, Article 760
7. Relevant 'UL' Standards:
 8. UL 864/UOJZ,
 9. APOU Control Units for Fire Protective Signaling Systems
 10. UL 268 Smoke detectors for fire protective signalling systems
 11. UL 268A Smoke detectors for duct applications
 12. UL 521 Heat detectors for fire protective signalling systems
 13. UL 228 Door holders for fire protective signalling systems
 14. UL 1480 Speakers for fire protective signalling systems
 15. UL 1971 Standard for visual signalling appliances
 16. UL 1711 Amplifiers for fire protective signalling systems.
- B. The cables used for fire alarm system shall meet the following standards:
 1. BS6387 Fire and Mechanical Tests
 2. IEC 331 Fire Test
 3. BS4066-3/IEC332-3 Flame Propagation
 4. BS6425-2/IEC754-2 Acid Gas Emission Test
- C. All the equipment shall operate reliably under the following environmental conditions:
 1. Ambient Temperature 4 to 52° C
 2. Relative Humidity Max. 95%

1.04 SUBMITTALS

- A. The submittal shall include the following as minimum but not limited to,



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Section: 28 31 00 (Fire Detection And Alarm System)

B. Manufacturers Technical Data

1. During the time of the contract and before substantial completion of the electrical installation, submit to ENGINEER three(3) copies of descriptive literature, technical data, maintenance recommendations(from the equipment manufacturer), catalogues etc

C. Installation Instructions

D. Calculations

1. Forward calculations and data for battery sizing calculations for the power supply.

E. Interfacing details

1. Details of interfacing with the various systems indicated and sequence of operation in case of alarm activation/fire situations, cause and effect program shall be submitted for ENGINEER review/approval

2. The contractor shall obtain approval from the local civil defence authority having jurisdiction for the fire alarm system installation for any changes that may be made to the original drawings as approved for the project. Detailed shop drawings shall be prepared and submitted for ENGINEER approval prior to submission to the Local Civil Defence Authority. All shop drawings shall be approved by the Local Civil Defence Authority prior to proceeding with the works.

F. Detailed Shop drawings.

G. On completion of the installation and testing, submit to THE ENGINEER 3 copies of As-built drawings, diagrams, operating instructions and descriptive literature, assembled in loose leaf binders and identified by Works.

H. Special testing tools list and spare parts recommended for 2 year in accordance to THE ENGINEER approval to be handed over to THE ENGINEER.

I. Provide necessary training for THE ENGINEER staff on the system installed by trained personnel of the supplier by the system's manufacturer. Training period and no. of staff to be trained shall be as per ENGINEER approval.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish and install a complete analogue addressable Fire Alarm and Voice evacuation system as described herein and as shown on the plans to be wired, connected, and left in first class operating condition.

1. The system consist of stand alone analogue addressable fire alarm control panel in each building with provision for networking with the Central Monitoring panel or Repeater panel.



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Section: 28 31 00 (Fire Detection And Alarm System)

2. The stand-alone fire alarm panel shall provide a local control for the system in the related block whereof the panel is installed while the command centre shall provide a control for the complete system. A system alarm resetting shall only be possible from the local fire alarm panel.
3. The Bell circuits shall be programmed in the control panel to have primary or secondary (or) sequential bell ringing. With time delays if necessary as instructed by THE ENGINEER during commissioning.
4. In case of an alarm the bell shall ring as indicated above. The AHUs in the related fire zone shall be switched off and a pre-recorded alarm message shall be enunciated through the public address system.
5. The (AHU's) Air handling units shall be interlocked with the fire alarm control panel for tripping purpose during fire condition.
6. The system shall be interlocked with the public address system to initiate a pre-recorded message announcement.
7. The system shall be interlocked with the security access control system to release the door locks in case of fire, however exact sequence of operation/control shall be to ENGINEER approval.
8. The system shall also interface with elevator control system; sequence of elevator recall in case of alarm activation shall be programmed in accordance with ENGINEER requirements and to their approval.
9. The system shall be Analogue addressable concept with closed loop initiating device circuits, individual zone supervision, individual indicating appliance circuit supervision, incoming and standby power supervision. Include control panel, manual pull stations, automatic fire detectors, sounders, enunciator, remote control devices, all wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.

2.02 FIRE ALARM CONTROL PANEL

- A. Where shown on the plans, and as recommended by system manufacturer, provide and install a Fire Alarm Control Panel. Construction shall be modular with solid state, microprocessor based electronics with plug-in modules. It shall display only that primary controls and displays essential to operation during a fire alarm condition.
- B. A local audible device shall sound during Alarm, Trouble or supervisory conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This audible device shall also sound differently during each keypress to provide an audible feedback (chirp) to ensure that the key has been pressed properly.

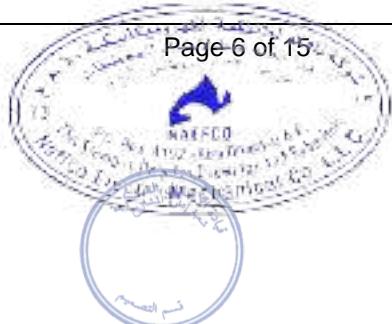


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Section: 28 31 00 (Fire Detection And Alarm System)

- C. The fire alarm control panel shall allow for loading or editing special instructions and operating sequences as required. The system is to be capable of onsite programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes. All software operations are to be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
- D. The system Initiating & Notification circuit to be provided with minimum of 20% spare for connecting any future device as necessary.
- E. Control Panel & Operation
 - 1. Under normal condition the front panel shall display a "SYSTEM NORMAL" message and the current time and date.
 - 2. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steadily for trouble and supervisory conditions.
 - 3. The panel shall display the following information relative to the abnormal condition of a point in the system:
 - a. Custom location label
 - b. Type of device (i.e.; smoke, pull station, water flow).
 - c. Point status (i.e.; alarm, trouble).
 - 4. Alarm Silencing: Should the "Alarm Silence" button be pressed all alarm signals shall cease operation.
 - 5. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied.
 - 6. Function Keys
 - a. Additional function keys shall be provided to access status data for all system points. As a minimum the status data shall include Disable/Enable Status, Verification Tallies of Initiating Devices, Acknowledge Status, etc.
- F. History Logging
 - 1. In addition to any required printer output, the control panel shall have the ability to store a minimum of three hundred (300) events in an alarm log plus a minimum of three hundred (300) events in a separate trouble log.
 - 2. The system shall be capable of being tested by one person. While in testing mode, the alarm activation of an initiating device circuit shall be silently logged as an alarm condition in the historical data file. The panel shall automatically reset itself after logging of the alarm.



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Section: 28 31 00 (Fire Detection And Alarm System)

G. System Trouble Reminder

1. Should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at pre-programmed time intervals to act as a reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable to suit the user's application.

H. Detection Operation

1. The control panel shall maintain a moving average of the sensors' smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. The system shall automatically maintain constant smoke obscuration sensitivity for each sensor (via the floating threshold) by compensating for environmental factors. The smoke obscuration sensitivity shall be adjustable.
2. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each sensor:
 - a. primary status
 - b. device type
 - c. present average value
 - d. present sensitivity selected*
 - e. peak detection values*
 - f. Sensor range (normal, dirty, etc.).

3. At least 1000 individually identified sensors as well as conventional initiating device and indicating appliance circuits shall be supported within a single control panel.

I. LED Operation

1. The alarm LED shall flash on the control panel until the alarm has been acknowledged.
2. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone after acknowledged shall flash the alarm LED on the control panel and the panel display shall show the new alarm information.
3. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone after acknowledged shall flash the alarm LED on the control panel and the panel display shall show the new alarm information.
4. A pulsing alarm tone shall occur until acknowledge.



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Section: 28 31 00 (Fire Detection And Alarm System)

J. Alarm Verification

1. The activation of any system smoke detector shall initiate an Alarm Verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If, within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute the system is to resume normal operation. The Alarm Verification is to operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation is to be selectable by device.

K. Manual Evacuation

1. A manual evacuation switch shall be provided to operate the systems alarm indicating appliances. Other control circuits shall not be activated. However, a true alarm shall be processed as described previously.

L. Alarm & Trouble Conditions

1. Alarm and trouble conditions shall be immediately displayed on the control panel front alphanumeric display.

M. Supervision

1. All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble, particularly for the AHU and pressurization fans.
2. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green "power on" LED shall be displayed continuously while incoming power is present. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel and the remote annunciator.
3. The System Expansion Modules shall be electrically supervised for module placement. Should a module become disconnected from the controls, the system trouble indicator must illuminate and audible trouble signal must sound.
4. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

N. Power Requirements

1. 240 VAC power via a dedicated fused disconnect circuit shall be provided for each panel.



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2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 240 VAC power in a normal supervisory mode for a period of twenty-four (24) hours with 30 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
3. All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.
4. Batteries shall be of the Sealed lead acid type with a minimum life expectancy of 10 years and mounted in suitable enclosure.

2.03 STAND ALONE FIRE ALARM PANEL

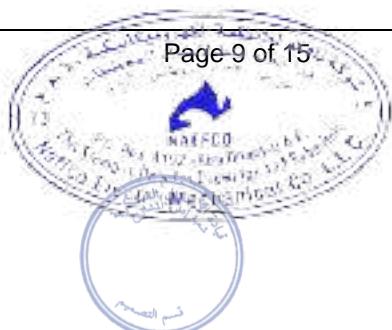
- A. This panel shall have the same features specified above but, it shall cater only for the circuits connected to it and it shall be possible to acknowledge, silence and reset an alarm/trouble from the panel through the proper access level.

2.04 FIRE ALARM REPEATER PANEL

- A. The fire alarm repeater panel shall consist of LCD display to annunciate all display on the main fire alarm command centre, the panel does not require to have any control feature.

2.05 ADDRESSABLE PERIPHERAL NETWORK

- A. Communication with Addressable devices: The system must provide communication with all initiating and control devices individually. All of these devices are to be individually annunciated at the control panel. Annunciation shall include the following conditions for each point.
 1. Alarm
 2. Trouble
 3. Open
 4. Short
 5. Ground
 6. Device Fail/Or Incorrect Device.
- B. All addressable devices are to have the capability of being disabled or enabled individually.
- C. Addressable devices may be multidropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.



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Section: 28 31 00 (Fire Detection And Alarm System)

2.06 IDENTIFICATION OF ADDRESSABLE DEVICES

- A. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. Hard wire addressable system shall be preferred in order to maintain the integrity of the system.
- B. Control pushbutton switches - for: alarm silence, alarm acknowledge, supervisory reset, display time and up to (4) control keys for programmable operation duplicating the control panel switches. A key "enable" deactivates the control switches.
- C. Tone alert - Duplicates the control panel tone alert during alarm & trouble conditions:
 1. System trouble LED
 2. Power on LED

2.07 ENCLOSURE(S)

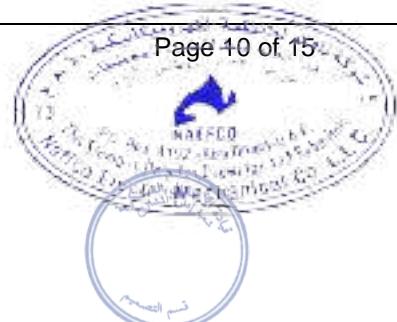
- A. Provide cabinet of sufficient size to accommodate the aforementioned equipment. The cabinet shall be equipped with locks and solid transparent door panel(s) providing freedom from tampering yet allowing full view of the various lights and controls.

2.08 DIGITAL COMMUNICATOR

- A. Provide Digital Communicator at the Main Control Panel locations to transmit common fire and fault alarm to an indicator panel at the remote fire station panel.
- B. The transmit equipment to be compatible to operate through leased telephone lines.
- C. The communicator shall be UL Listed and FM approved.

2.09 PERIPHERAL DEVICES

- A. Photo Electric Detectors
 - 1. The photoelectric smoke detectors shall be capable of detecting smoke from fires. The detectors shall have 360 degree smoke entry.
 - 2. The Photo electric smoke detectors shall be U.L listed
 - 3. The design of the optical smoke detectors sensing chamber shall be optimised to minimise the effect of the dust deposits over a period of time
 - 4. The optical smoke detectors shall incorporate screens designed to prevent all but the very small insects from entering the sensing chamber.
 - 5. Detector shall be multi-criteria operation built into the microprocessor/pre-programmed chip by the central panel.



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Section: 28 31 00 (Fire Detection And Alarm System)

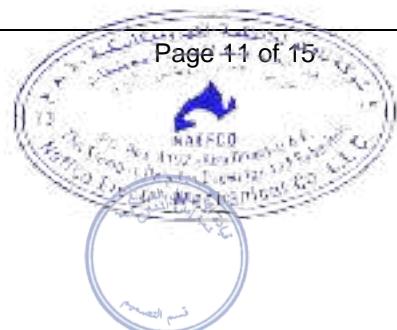
6. The optical smoke detectors shall include RFI screening and feed-through connecting components to minimise the effect of radiated and conducted electrical interference.
7. The optical smoke detectors shall incorporate an LED, clearly visible from the outside, to provide indication of alarm actuation.
8. The optical smoke detectors shall incorporate a magnetically operated functional test facility.
9. The optical smoke detectors shall have EMI/RFI shielded electrons.
10. The optical smoke detectors shall incorporate an LED clearly visible from the outside, to provide indication of alarm and normal conditions.

B. Heat Detectors

1. The heat detectors shall be capable of self restoring and providing rate of rise and fixed temperature sensing.
2. The heat detectors shall be U.L listed
3. The heat detectors shall employ two heat-sensing elements with different thermal characteristics to provide a rate of rise dependent response.
4. The temperature sensing elements and circuitry of the heat detectors shall be coated with epoxy resin to provide environmental protection.
5. The heat detectors shall incorporate a magnetically operated functional test facility.
6. The heat detectors shall have EMI/RFI shielded electrons.
7. The heat detectors shall incorporate an LED, clearly visible from the outside, to provide indication of alarm and normal conditions.

C. Manual Break Glass Call Point

1. The manual call points shall monitor and signal to the Control Panel the status of a switch operated by a 'break glass' assembly with N.O/N.C contacts.
2. The manual call points shall be U.L approved.
3. The manual call points shall be capable of operating by means of thumb pressure and not require a hammer or by pull station double action.
4. The manual call points shall be field programmable to be alert or evacuation.
5. The manual call points shall be capable of being tested using a special 'key' without the need for shattering the glass.
6. The addressable manual call points shall have built in electronics with dip switch for addressing or auto addressing.



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Section: 28 31 00 (Fire Detection And Alarm System)

7. The conventional manual call points shall be connected to addressable loop through interface modules.
8. The conventional breakglass units to be provided in non-conditioned areas such as workshop area and as shown on drawings.

D. Addressable Interface Modules

1. The addressable contact interface module shall provide monitoring of the status of switched input signals from either normally open contacts from conventional devices.
2. The addressable contact monitoring module shall be capable of deriving its power directly from the addressable loop or from the control panel.
3. The addressable contact monitoring module shall be enclosed in a pre-fabricated enclosure.

E. Line Isolator Module

1. The line isolator module shall provide protection on the addressable loop by automatically disconnecting the section of wiring between two modules where a short-circuit has occurred.
2. The line isolator module shall derive power directly from addressable loop
3. The line isolator module shall be installed for every 15 devices and as shown in layout drawings.

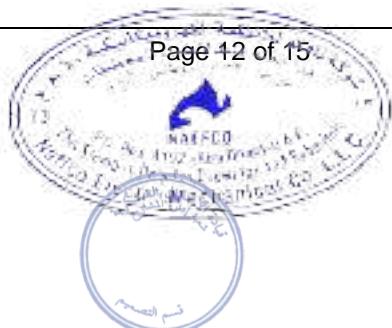
F. Circuit Protector

1. Circuit protector shall be provided on all fire alarm external wiring to protect the system against lightning or high transient voltage. The protector shall be located as close as practicable to the point at which the circuit leave or enter a building.
2. The circuit protector shall have line to line response time of less than 1 nano second and capable of accepting greater than 2000 Ampere at 28 volt.

G. Beam Detector

1. The Beam Detector shall be microprocessor based and shall have automatic gain control and temperature compensation.
2. The separate transmitter/receiver shall be capable of long range coverage up to 100 Meter and have six sensitivity level settings.
3. The detector shall include normal, alarm and trouble LED indicators,
4. A remote indicator and test unit shall be installed at low level in the corridor to indicate the status of the beam detector and which will be used to test the alarm function of the detector.

H. Photoelectric duct mounted detector



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1. Photoelectric duct sensors shall be of the solid state photoelectric type and shall operate on the light scattering, photodiode principle. To minimize nuisance alarms, detectors shall have a 30 mesh insect screen and be designed to ignore invisible particles or smoke densities that are below the factory set point. No radioactive material shall be used.

I. Fire Alarm Bells

1. The fire alarm bells shall be U.L listed
2. The fire alarm bells shall be wired directly from the panel in Multi circuit.
3. The fire alarm bells circuits shall be complete with end of line resistors for maintaining purpose.
4. The fire alarm bell shall be of the light weight Aluminium alloy construction, water proof and painted red.
5. The bell shall be vibrating type with low current consumption
6. The bell shall be 6" heavy duty suitable for internal and external operation as required.
7. It shall give a minimum sound level of 90 dB at 1 meter.
8. The fire alarm bell shall be controlled from the loop. Sequencing of bell controls shall be determined during construction and can be programmed at control panel.

J. Fire Alarm Bell with Strobe Light

1. Audible/Visible notification appliance combines a high intensity strobe with a low current electronic horn.
2. Horn output shall be a steady harmonically rich sound that can be easily coded by the controlling notification appliance circuit.
3. 24V DC operation
4. UL listed or approved equal.
5. Strobe light shall be of xenon with impact resistant polycarbonate lens.
6. Strobe light intensity shall be selected from manufacturers standard product range depending on the location where it shall be installed and the area coverage. It shall not be less than 30 candela.
7. It shall be of surface mounting/semi flush mounting.
8. Minimum sound level shall be as PE UL464.

K. Temperature



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-
1. Control Panel : 0° C to 48° C
 2. Peripheral Devices : 10° C to 50° C (For conventional devices).
0° C to 49° C (Addressable devices)
 3. Humidity : 95%
 4. Outdoor Equipment : IP65.

PART 3 - EXECUTION

3.01 INSTALLATION

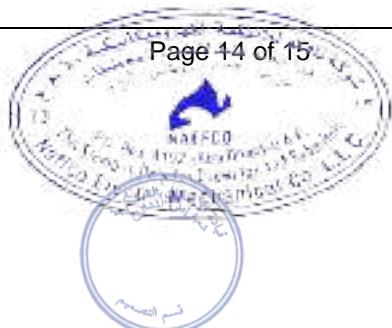
- A. Provide and install the system in accordance with the plans and specifications, all applicable codes, local authority requirements and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC - Article 760 A and C, Power-Limited Fire Protective Signaling Circuits or if required may be reclassified as non-power limited and wired in accordance with NEC-Article 760 A and B.
- B. The manufacturer's authorized representative shall provide onsite supervision of installation.

3.02 TYPE OF CABLES

- A. Fire resistant cables complying with BS 6387 Category CWZ shall be used for the wiring of the fire alarm system. The cabling shall be carried out in Class - A. Cable running through walls, ceilings, roofs etc. shall be provided with fire stops.

3.03 CABLING AND WIRING

- A. The installation of all wiring, cable and equipment shall be in accordance with NFPA 70. National Electric Code and specifically with Article 760, Fire Protection signaling systems and in accordance with the local codes and standards.
- B. Wiring for the fire detection and alarm system
- C. Wiring within any control equipment shall be readily accessible without removing any components or parts.
- D. All internal fire alarm cabling shall be fire rated cables.
- E. Wiring for 240 V AC power to each FCP shall be minimum 2.5 mm². Wiring for all bell circuits shall be minimum 2.5 mm² and wiring for all signaling circuits shall be minimum 1.5 mm².
- F. All cabling shall be concealed in the building fabric for all conditioned areas.
- G. Cables fixed to cable trays above ceilings shall be installed on a single layer to enable access to all cables.



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3.04 TESTING AND COMMISSIONING

A. Preliminary Tests

1. Upon the completion of the installation, the system shall be subject to functional and operation performance tests including test of each installed initiating and notification appliance. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found corrections shall be made and the system shall be retested to assure that it functions.

B. Acceptance Test

1. Provide the service of competent, factory – trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and commissioning of the system. Testing shall be in full accordance with NEPA 72 section 7.2.2 :

C. Conductor Testing

1. Prior to connection of the equipment all conductors shall be tested.

D. System Testing

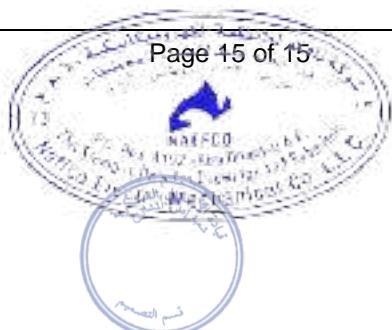
1. Verify that the control unit is in the normal supervisory condition as detailed in the manufacturers manual.
2. Test each initiating device and indicating appliance for alarm operation and trouble indication.
3. Test the operation of control module for proper response
4. Test all primary power supplies.
5. Test all secondary power supply
6. Verify that each test signal is properly reported and received at the main fire alarm panel.

E. Fire Alarm Schedule to be completed by the Vendor during tender. One schedule to be completed for each panel

3.05 WARRANTY

- A. The contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of taking over certificate or from the date of first beneficial use.

END OF SECTION





SECTION 21 13 00

FIRE SUPPRESSION SPRINKLER SYSTEMS

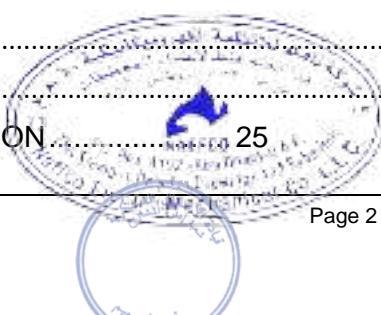
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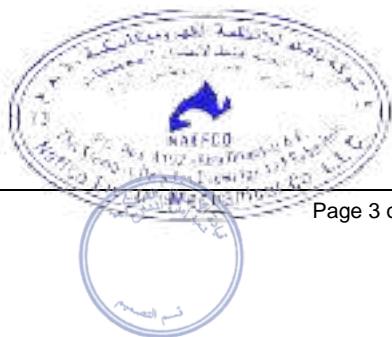


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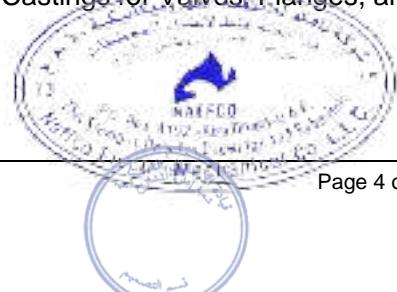
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PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. AMERICAN IRON AND STEEL INSTITUTE (AISI)
 - a) AISC/AISI 121 (2004) Standard Definitions for Use in the Design of Steel Structures
2. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - a) AWWA C104/A21.4 (2008) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - b) AWWA C110/A21.10 (2008) Ductile-Iron and Gray-Iron Fittings for Water
 - c) AWWA C111/A21.11 (2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - d) AWWA C151/A21.51 (2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
3. ASME INTERNATIONAL (ASME)
 - a) ASME A112.18.1 (2005) Standard for Plumbing Fixture Fittings
 - b) ASME B16.1 (2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
 - c) ASME B16.3 (2006) Malleable Iron Threaded Fittings, Classes 150 and 300
 - d) ASME B16.34 (2009) Valves - Flanged, Threaded and Welding End
 - e) ASME B16.39 (2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
 - g) ASME B16.4 (2006) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
 - h) ASME B16.9 (2007) Standard for Factory-Made Wrought Steel Butt welding Fittings
 - i) ASME B31.1 (2007; Addenda 2008; Addenda 2009) Power Piping
4. ASTM INTERNATIONAL (ASTM)
 - a) ASTM A 1008/A 1008M (2009a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
 - b) ASTM A 126 (2004) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings





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- c) ASTM A 135/A 135M (2009) Standard Specification for Electric-Resistance-Welded Steel Pipe
- d) ASTM A 183 (2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
- e) ASTM A 197/A 197M (2000; R 2006) Standard Specification for Cupola Malleable Iron
- f) ASTM A 234/A 234M (2007) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
- g) ASTM A 307 (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- h) ASTM A 53/A 53M (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- i) ASTM A 563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts
- j) ASTM A 563M (2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
- k) ASTM A 568/A 568M (2009a) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
- l) ASTM B 370 (2009) Standard Specification for Copper Sheet and Strip for Building Construction
- m) ASTM B 749 (2003; R 2009) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate
- n) Products
- o) ASTM C 592 (2008a) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
- p) ASTM C 920 (2008) Standard Specification for Elastomeric Joint Sealants
- q) ASTM D 2000 (2008) Standard Classification System for Rubber Products in Automotive Applications
- r) ASTM F 568M (2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

5. FM GLOBAL (FM)

- a) FM P7825a (2005) Approval Guide Fire Protection

6. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

- a) MSS SP-58 (2009) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture

7. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- a) NFPA 13 (2010) Installation of Sprinkler Systems





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- b) NFPA 13E (2010) Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems
- c) NFPA 14 (2010) Standard for the Installation of Standpipe, Private Hydrants and Hose Systems
- d) NFPA 1961 (2007) Standard on Fire Hose
- e) NFPA 1963 (2009) Standard for Fire Hose Connections
- f) NFPA 24 (2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- g) NFPA 291 (2010) Recommended Practice for Fire Flow Testing and Marking of Hydrants
- h) NFPA 70 (2008; AMD 1 2008) National Electrical Code - 2008 Edition

8. U.S. DEPARTMENT OF DEFENSE (DOD)

- a) MIL-C-18480 (Rev B; Notice 2) Coating Compound, Bituminous, Solvent, Coal-Tar Base
- b) MIL-STD-101 (Rev B) Color Code for Pipelines & for Compressed Gas Cylinders

9. U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- a) FED-STD-595 (Rev C) Colors Used in Government Procurement
- b) FS FF-S-325 (Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
- c) FS WW-P-421 (Rev D) Pipe, Cast, Gray and Ductile Iron, Pressure (For Water and Other Liquids)

10. UNDERWRITERS LABORATORIES (UL)

- a) UL 19 (2001) Standard for Lined Fire Hose and Hose Assemblies
- b) UL 6 (2007) Standard for Electrical Rigid Metal Conduit-Steel

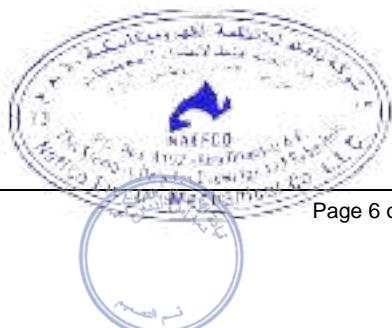
11. UAE FIRE & LIFE SAFETY CODE OF PRACTICE

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

a. SD-01 Preconstruction Submittals

1- Hydraulic Calculations:





Submit hydraulic calculations to the Engineer for approval.

b. SD-02 Shop Drawings

Shop Drawings and Manufacturer's Literature: Submit shop drawings and manufacturers literature on fire protection system components, according to the following listing:

1. Hanger Supports
2. Brackets
3. Hangers
4. Clamps
5. List of Manufacturers
6. Piping Layout and Details
7. Valves
8. Piping materials
9. Fittings
10. Leak Test Certificates
11. Operation and Maintenance Instructions
12. Mechanical couplings
13. Fire Department Breaching Points
14. Alarm valves
15. Water motor alarms
16. Pressure switch
17. Water flow detector
18. Fire hose cabinets
19. Valve tamper switch
20. Backflow preventer
21. Compressor
22. Sprinkler Heads
23. Underground Piping Materials

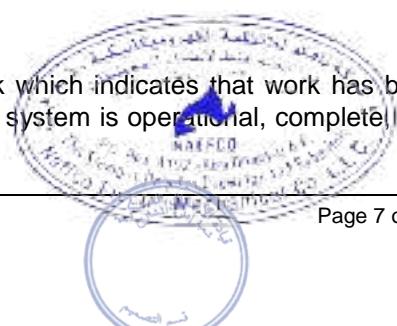
c. SD-03 Product Data

1. Technical Data

Submit manufacturer's technical product data and installation instructions for fire protection materials and products. Manufacturer's literature and data sheets are to be submitted indicating the necessary installation dimensions, weights, materials and performance information. The performance is to include capacities, pressure drop, design and operating pressure, temperatures, and similar data. Complete electrical data, including power conditions, and identifying types and numbers, to be included. Where pertinent, electrical diagrams are to be provided. Literature and data sheets may be provided by standard sales sheets marked to indicate the specific equipment provided.

2. Certificate of Installation:

Submit certificate upon completion of fire protection piping work which indicates that work has been tested in accordance with NFPA 13 and NFPA 14, and also that system is operational, complete, and has no defects.





3. As Build Drawings:

At project closeout, submit As Build drawings of installed fire protection piping and products; in accordance with requirements of Division 1.

4. Maintenance Data:

Submit operation and maintenance data and parts lists for fire protection materials and products. Include this data, product data, shop drawings, approval drawings, approval calculations, certificate of installation, and record drawings in maintenance manual; in accordance with requirements of Division 1. Contractor is to furnish data covering model, type and serial numbers, capacities, maintenance and operation of each item of equipment or apparatus. Operating instructions are to cover all phases of control.

5. Valve Schedule:

Furnish a printed schedule, in duplicate, describing each valve by number, giving locations and service for which used. System identification to be as stipulated in the other sections of these specifications. One copy of this schedule is to be mounted under glass in a simple black enamel steel frame and hung in the mechanical equipment room where directed. The other copy is to be submitted to the Engineer before completion of the work.

D. SD-05 Design Data

Design Analysis and Calculations

E. SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with the paragraph entitled, "System Testing," of this section

1. Pressure Tests
2. System Operating Tests
3. Air Tests
4. Valve-Operating Tests
5. Drainage Tests

Data which describes more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Submit one original for each item and clear, legible, first-generation photocopies for the remainder of the specified copies. Incomplete or illegible photocopies will not be accepted. Partial submittals will not be accepted.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications of Installer





Prior to commencing work, submit data showing that the specialized sub-Contractor has successfully installed fire extinguishing standpipe and sprinkler systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having the required experience. Include the names and locations of at least five installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system, and certify that the system has performed satisfactorily for a period of at least 18 months. Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings shall be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by UAE Civil Defence. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

1.3.2 System As-Built Drawings

Upon completion, and before final acceptance of the work, submit a complete set of as-built drawings of each system. Furnish as-built (record) working drawings in addition to the as-built drawings required by Division 1, "General Requirements."

1.4 DELIVERY, STORAGE AND HANDLING

Protect stored equipment from weather, humidity and temperature variations, dirt, dust, and other contaminants





PART 2 PRODUCTS

2.1 GENERAL

Fire-protection system materials and equipment provided under this section shall conform to the requirements of Underwriters Laboratories (UL) or the Factory Mutual (FM P7825a) Approval Guide. Products with UL label or seal or listing in UL 6, and products with FM label or listed in the FM P7825a Approval Guide are acceptable fire-protection system materials and equipment. Materials and equipment furnished shall be compatible with existing system. Equipment and Performance Data shall be submitted for fire protection sprinkler systems consisting of information on use life, system functional flows, safety features, and mechanical automated details.

2.2 UNDERGROUND PIPING MATERIALS

Ells, tees, reducing tees, wyes, couplings, increasers, crosses, transitions, and end caps shall be the same type and class of material as the pipe or shall be material having equal or superior physical and chemical properties.

2.2.1 Type CIWP

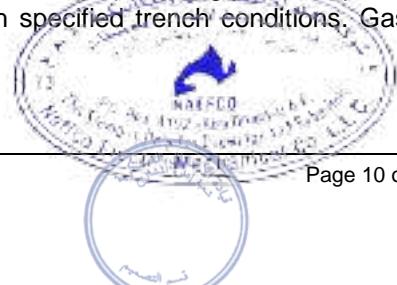
Cast-iron water pipe shall be mechanical joint or push-on type, centrifugally cast, UL listed and labeled, conforming to FS WW-P-421 and, as applicable, to AWWA C151/A21.51, AWWA C110/A21.10, AWWA C111/A21.11. Piping shall be Class 150. Bell-and-spigot fittings shall conform to AWWA C110/A21.10.

For FS WW-P-421 wall-thickness criteria only, depth of cover shall be 1500 millimeter unless drawings indicate less, in which case, drawing requirements shall apply; field-laying conditions shall be B (flat-bottom trench, without blocks, tamped backfill).

Flanged cast-iron pipe fittings shall be Class 125 conforming to ASME B16.1. Piping and fittings shall be coated on the [inside] and [outside] with a bituminous sealer in accordance with AWWA C104/A21.4. [Piping and fittings shall be coated on the inside with a mortar lining in accordance with AWWA C104/A21.4.] Restraining joint against endwise separation due to internal pressure may be accomplished by NFPA-recommended metal harness consisting of clamping devices and bolting or by hardened-metal retainers molded into a push-on gasket and engaged by a groove in the spigot end. Where electrical continuity is indicated, pipe shall be supplied with factory-brazed heavy cross section copper connectors to be joined with copper fasteners upon joint assembly. Connectors, as a minimum, shall be equal to No. 1/0.

2.2.2 Type DIWP

Ductile-iron water pipe shall be mechanical-joint or push-on type, centrifugally cast, UL listed and labeled, conforming to applicable provisions of AWWA C111/A21.11, and AWWA C151/A21.51. Wall-thickness criteria shall be 1380 kilopascal 200-pounds per square inch (psi) working pressure plus 690 kilopascal 100-psi surge allowance, AASHTO H-20 loading with specified trench conditions. Gasket elastomeric shall be chloroprene.





Piping shall be coated on the [inside] and [outside] with a bituminous sealer in accordance with AWWA C104/A21.4. [Piping and fittings shall be coated on the inside with a mortar lining in accordance with AWWA C104/A21.4.] Restraining joint against endwise separation due to internal pressure may be accomplished by using a metal harness consisting of clamping devices and bolting or by hardened-metal retainers molded into a push on gasket and engaged by a groove in the spigot end.

Where electrical continuity is indicated, pipe shall be supplied with factory-brazed heavy cross section copper connectors to be joined with copper fasteners upon joint assembly. Connectors, at a minimum, shall be equal to No. 1/0

2.3 ABOVEGROUND PIPING MATERIALS

2.3.1 Type BCS - Black Carbon Steel

Pipe(DN6 through DN40) : Schedule 40 furnace butt weld black-carbon steel conforming to ASTM A 53/A 53M, or ASTM A 135/A 135M, Type F furnace butt welded; Schedule 10 conforming to ASTM A 135/A 135M, Grade B

Pipe (DN50 through DN206, where indicated): Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53/A 53M or ASTM A 135/A 135M, Type E (electric-resistance welded), Grade B, or Type S (seamless), Grade B; Schedule 10 conforming to ASTM A 135/A 135M, Grade B

Pipe (DN250): Schedule 30 black carbon steel conforming to ASTM A 53/A 53M, Type E (electric-resistance welded) or Type S (seamless)

Unions (DN50 and under): 2068 kilopascal working steam pressure (wsp) female, screwed, black malleable iron, with ground joint and brass-to-iron seat conforming to ASME B16.39

Standard pipe couplings: Extra-heavy screwed black steel

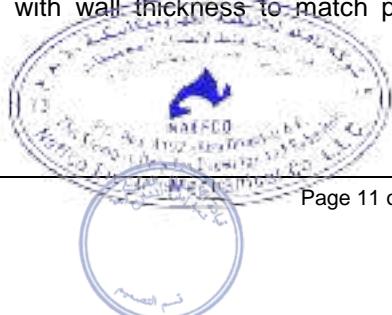
Grooved pipe couplings (all sizes): 1207 kilopascal minimum working pressure with a housing fabricated in two or more parts of black malleable-iron castings. Coupling gasket shall be molded of synthetic rubber, conforming to requirements of ASTM D 2000. Coupling bolts shall be oval-neck, track-head type with heavy hexagonal nuts, conforming to ASTM A 183

Fittings (DN100): 1207 kilopascal working pressure, cast iron, screwed, conforming to ASTM A 126, Class A, and ASME B16.4

Fittings (DN150): 1207 kilopascal working pressure, cast iron, conforming to ASTM A 126, Class A, screwed, conforming to ASME B16.4, or flanged, conforming to ASME B16.1

Fittings (DN200 and under): Couplings shall be rolled-groove type or mechanical locking (push-on) type. Grooves for rolled-groove type shall be rolled only; cut grooving will not be allowed. Rolled grooves shall be dimensionally compatible with the couplings.

Grooved fittings (all sizes): 1207 kilopascal working pressure fittings used with grooved couplings shall be fabricated of black malleable-iron castings. If a manufacturer's standard-size malleable-iron fitting pattern is not available, fabricated fittings shall be used; fittings shall be fabricated from Grade B seamless-steel pipe and long-radius seamless welding fittings, with wall thickness to match pipe, conforming to ASTM A 234/A 234M and ASME B16.9.





2.3.2 Type GCS - Galvanized Carbon Steel

Pipe (DN15 through DN250 and where indicated): Schedule 40 seamless or electric resistant welded galvanized steel conforming to ASTM A 53/A 53M, Type E (electric-resistance welded) or Type S (seamless). Type F (furnace butt welded continuous welded) is acceptable for sizes less than DN50.

Fittings (all sizes): 1034 kilopascal working pressure banded, galvanized, malleable, screwed, conforming to ASTM A 197/A 197M and ASME B16.3

Fittings (DN65 and over): 862 kilopascal working pressure cast-iron flanges and flanged fittings conforming to ASTM A 126, Class A and to ASME B16.1

Grooved pipe couplings (all sizes): 1207 kilopascal minimum working pressure with a housing fabricated in two or more parts of galvanized malleable-iron castings. Coupling gasket shall be molded of synthetic rubber, conforming to requirements of ASTM D 2000. Coupling bolts shall be oval-neck, track-head type with heavy hexagonal nuts, conforming to ASTM A 183.

Grooved fittings (all sizes): 1207 kilopascal working pressure fittings used with grooved couplings shall be fabricated of galvanized malleable-iron castings. If a manufacturer's standard-size malleable-iron fitting pattern is not available, fabricated fittings shall be used; fittings shall be fabricated from Grade B seamless steel pipe and long-radius seamless welding fittings, with wall thickness to match pipe, conforming to ASTM A 234/A 234M and ASME B16.9.

Unions (DN50 and under): 2070 kilopascal working pressure female, screwed, galvanized malleable iron, with brass-to-seat and ground joint

2.4 SUPPORTING ELEMENTS

Piping system components and miscellaneous supporting elements shall be provided, including, but not limited to, building-structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical-pipe attachments; horizontal-pipe attachments; restraining anchors; and guides. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, natural, and other external forces.

Supporting elements shall be FM approved or UL listed and shall conform to ASME B31.1, MSS SP-58, and ASME B16.34.

2.4.1 Building-Structure Attachments

2.4.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to FS FF-S-325:

Group I: Shield, expansion (lead, bolt, and stud anchors)

Group II: Shield, expansion (bolt anchors), Type 2, Class 2, Style 1 or 2

Group III: Shield, expansion (self drilling tubular expansion shell bolt anchors)

Cast-in floor-mounted equipment-anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support mechanical-systems components.





2.4.1.2 Beam Clamps

Beam clamps shall be center-loading Types 21, 28, 29, and 30, UL listed, cataloged, and load-rated commercially manufactured products. Type 20 beam clamps shall be used for pipe DN50 and under. Two Type 25 beam clamps shall be used per point of pipe support.

2.4.1.3 C-Clamps

C-clamps shall [not be used]

2.4.1.4 Inserts, Concrete

Concrete inserts shall be constructed in accordance with the requirements of MSS SP-58 for Type 18 and ASME B16.34. When applied to piping in sizes DN50 iron pipe size (ips) and larger, and where otherwise required by imposed loads, a 300 millimeter length of 15 millimeter reinforcing rod shall be inserted and wired through wing slots.

2.4.2 Horizontal-Pipe Attachments

2.4.2.1 Single Pipes

Piping in sizes up to and including DN50 ips shall be supported by Type 1, 5, 6, 7, 9, 10, 11, or 12 solid, split-ring, or band type attachments.

Piping in sizes DN65 and larger shall be supported by Type 1, 2, 3, or 4 attachments or with Type 41 or Type 49 pipe rolls.

2.4.2.2 Parallel Fire-Protection Pipes

Trapeze hangers fabricated from approved structural steel shapes, with U-bolts, shall be used when so specified. Structural-steel shapes shall conform to supplementary steel requirements or the support shall be of commercially available, approved proprietary-design rolled steel.

2.4.3 Vertical-Pipe Attachments

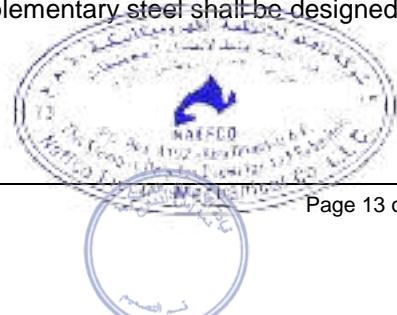
Single vertical-pipe attachments shall be Type 8 .

2.4.4 Hanger Rods and Fixtures

Only circular solid cross section rod hangers shall be used to connect building structure attachments to pipe-support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers. Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature changes, pipe accessibility, and adjustment for load and pitch.

2.4.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with AISC/AISI 121.





2.5 FIRE-DEPARTMENT BREECHING CONNECTIONS

Hose connections shall have National Fire hose standard-thread form and rocker lugs in accordance with NFPA 1963. Hose-connection sizes and threads shall be compatible with the equipment used by the fire department serving the facility.

2.5.1 Wall Siamese

Unit shall be cast brass or bronze flush-mounted escutcheon-plate type, with two DN65 , fire-department, swivel, female inlets; double-clapper valves; rocker-lug caps and chains; and cast-in function-identifying lettering. Finish shall be chrome-plated or polished surface. Chrome plate shall be in accordance with ASME A112.18.1.

2.5.2 Sidewalk Siamese

Unit shall be cast brass or bronze, with two DN65 , fire-department, swivel, female inlets; double-clapper valves; rocker-lug caps and chains; and cast-in function-identifying lettering. Finish shall be chrome-plated or polished surface. Chrome plate shall be in accordance with ASME A112.18.1. Unit shall be mounted on a Schedule 40 ASTM A 53/A 53M galvanized carbon-steel pipe with red-enamelled finish on prime-coated surface. All surfaces embedded in concrete or below grade shall be protected with a 0.508 millimeter thick bituminous coating

2.5.3 Wall Hydrant

Unit shall be of cast brass or bronze flush-mounted escutcheon-plate type with two DN65, fire-department, male outlets; rocker lug caps and chains; and cast-in function-identifying lettering. Finish shall be chrome-plated or polished surface. Chrome plate shall be in accordance with ASME A112.18.1.

2.5.4 Roof Manifold

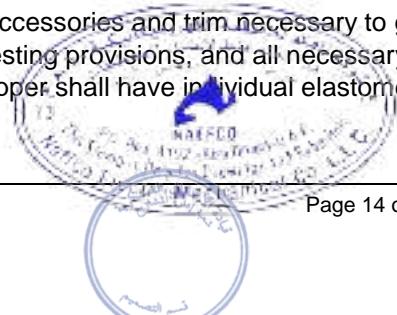
Unit shall be of cast brass or bronze, horizontal type, with two DN65, 1200 kilopascal rated hose valves fitted with rocker-lug caps and chains. Finish shall be rough body with polished trim.

2.6 RISER ALARM EQUIPMENT

Riser alarm equipment shall be UL listed or FM approved for fire-protection use.

2.6.1 Wet-Pipe Alarm Check Valve

Wet-pipe alarm check valve shall be complete with standard accessories and trim necessary to give an alarm and shall include pressure gages, retard chamber, testing provisions, and all necessary intercomponent piping, fittings, and valves. Pilot valve and clapper shall have individual elastomer seats.





2.6.2 Standard Check Valve

Check valve shall be FM-approved or UL-listed standard swing-check type with elastomer-disc seat. Pressure gages shall be provided on both sides of the clapper. Water-flow alarm shall be vane type.

2.6.3 Dry-Pipe Alarm Check Valve

Dry-pipe alarm check valve shall be complete with standard accessories and trim necessary to give an alarm, and shall include pressure gages, accelerator, priming provisions, testing provisions, and all necessary intercomponent compressed-air and water piping, fittings, and valves.

System shall include a trouble alarm indicating a loss of air pressure.

2.6.4 Water-Flow Alarm Device

Water-flow alarm devices shall be UL listed for the particular type of system.

2.6.4.1 Water Motor Gong Local Alarm

Assembly shall include a gong with an aluminum or chrome-plated brass hood with nonstaining weather-resistant mounting. Water motor shaft shall have tetrafluoroethylene bearings and an inlet strainer. Waste water shall drain as indicated.

2.6.4.2 Pressure Switch Remote Alarm

Pressure switch shall be wired to make or break a circuit depending on rise or fall of water pressure.

2.6.4.3 Vane-Type Flow Alarm

Vane-type flow alarm shall make or break an alarm circuit upon deflection by a volume of flowing water that equals or exceeds the capacity of a single sprinkler. Alarm shall have an instant-recycle pneumatic-retard time delay.

2.6.4.4 Electric Motor Gong

Electric motor gong shall be a 150 millimeter diameter bell, synchronous-motor type. Weather-exposed units shall be weatherproof and shall be provided with a weather hood. Assembly shall be constructed of nonstaining materials

2.7 DRY-PIPE MAINTENANCE AIR





2.7.1 Independent Source

Dry-pipe system air pressure shall be maintained by an independent Air Compressor mounted on the riser. Compressor shall be spring and elastomer vibration-isolated from the riser, of oil-free construction, complete with adjustable set point low-differential pressure switch, check valve, and necessary unloader and intercomponent piping and wiring. Spare inlet-air filter media shall be provided.

2.7.2 Continuous Source

Dry-pipe system air pressure shall be maintained by an adjustable set point low-differential-diaphragm pressure-reducing valve connected to 690 kilopascal facility compressed-air system to maintain air side of dry-pipe valve. Unit shall be entirely of nonferrous-metal construction with a replaceable cartridge inlet-air filter. Air-maintenance device shall be complete with intercomponent piping, fittings, and valves. Spare inlet-air filter media shall be provided.

2.7.3 Retard Orifice

Air-supply line near each dry-pipe valve shall be provided with an orifice union with a 3 millimeter orifice corrosion-resistant steel plate, externally identified, and a DN15 three-valve bypass around the orifice union.

2.8 STANDPIPE EQUIPMENT AND FIRE HOSE CABINET STATIONS

2.8.1 Fire Hose Cabinet Stations

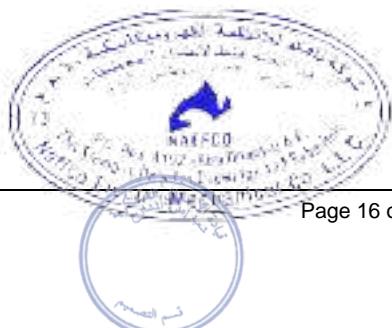
Fire hose cabinet stations shall be furnished with cabinet, fire hose rack, DN40 hose, valve, and spanner wrench.

2.8.2 Firehouse Racks and Hoses

Rack-and-hose assemblies shall be nipple mounted, swinging, semiautomatic, and red enameled. Racks shall be fitted with spring-friction retainer clip. Hoses shall be DN40 diameter, 20 meter long, cotton-polyester jacketed, rubber lined, mildew-proof, conforming to NFPA 1961, and UL approved for rack service. Couplings shall be rocker-lug type. A spanner, mounted in clips, shall be provided at each rack.

Rack valves shall be polished brass, 1200 kilopascal rated, DN65 angle valve with 65 millimeter 2-1/2-inch female to 40 millimeter male reducer, and fitted with automatic drain-vent device.

Hose nozzles shall be DN40 chemical hose thread, polished brass, adjustable fog, off-and-on solid-stream type.





2.8.3 Standpipe-Mounted Hose Racks and Hoses

Hose racks shall be suitable for specified hose length. Firehouse racks and accessories shall be red enameled, designed for standpipe mounting at an elevation high enough to avoid damage. Suitable clips or spring-loaded retainers shall be provided to prevent hoses from unwinding and hoses and nozzles from swinging from their mounted position until placed into service.

Rack hoses shall be DN40 diameter, 30 meter long, cotton-polyester jacketed, rubber lined and mildew-proof, conforming to [NFPA 1961] [UL 19]. Couplings shall be rocker-lug type. A spanner, mounted in clips, shall be provided at each rack.

Rack valve shall be polished brass, 1200 kilopascal rated, DN65 angle valve with 65 millimeter 2-female to 40 millimeter male reducer, and fitted with automatic drain-vent device.

Hose nozzle shall be DN40 chemical hose thread, polished brass, adjustable fog, off-and-on solid-stream type.

2.8.4 Hose Reels and Hoses

Hose reels, frames, and accessories shall be red enameled and suitable for specified hose diameter and length. Reels shall be fitted with a swivel and piping to allow continuous flow through hoses. Friction brakes shall be provided to prevent hoses from accidentally unwinding.

Hoses shall be 40 millimeter inside diameter, 45 millimeter outside diameter, 3-braid, single-jacket, 2070 kilopascal working pressure, 30 meter long, hard rubber or heavy duty synthetic cover, noncollapsible, and fitted with couplings. Hoses shall be red covered, flexible, nonkinking, and shall weigh not over 35 kilogram per 30 meter .

Couplings shall be hole type, one female swivel and one male, both with chemical hose thread (M44 - 3.175 male)

Reel control valve shall be 1200 kilopascal rated, quarter-turn, ball- or butterfly-valve, for quick-opening operation.

Hose nozzle shall be DN40 chemical hose thread, polished brass, adjustable fog, off-and-on solid-stream type.

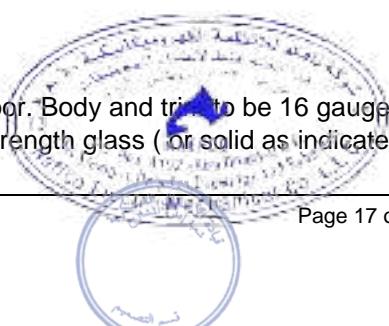
2.8.5 Standpipe Valve

Valve shall be DN65 angle hose type, 1200 kilopascal rated, with 65 millimeter female to 40 millimeter male reducer, 40 millimeter cap and chain, and chrome-plated polished brass.

In multistory buildings with fire pumps, valve shall include orifice plate to restrict discharge pressure to 450 kilopascal.

2.8.6 Fire-Hose Cabinet

- A. Recessed type, with stainless steel body and trim and door. Body and trim to be 16 gauge and door 20 gauge thickness. Door to have full panel double strength glass (or solid as indicated or





approved at site) with "Fire Hose" decal. Hose rack cabinet to be supplied from factory with the following equipment:

1. one 65 mm pressure restricting angle valve,
2. one 65 mm x 40 mm chrome finished brass reducer,
3. one stainless steel hose rack with rack nipple,
4. one 40 mm unlined linen fire hose 30 m long, with brass hose couplings attached.
5. one 40 mm brass nozzle, 250 mm long, 15 mm discharge, with chrome finish,
6. one 4.5 kg ABC nitrogen operated dry chemical fire extinguisher, with steel body and stainless steel finish.

B. Surface mounted type, with clear anodized, 16 gauge thick stainless steel body, trim and door. Door to have full panel double strength glass (or solid as indicated or approved at site) with "Fire Hose" decal. Hose rack cabinet to be supplied from factory with the following equipment:

1. one 65 mm pressure restricting angle valve,
2. one 65 mm x 40 mm chrome finished brass reducer,
3. one stainless steel hose rack with rack nipple,
4. one 40 mm unlined linen fire hose 30 m long, with brass hose couplings attached.
5. one 40 mm brass nozzle, 250 mm long, 15 mm discharge, with chrome finish,
6. one 4.5 kg ABC nitrogen operated dry chemical fire extinguisher, with stainless steel body .

C. Construction: Manufacturer's standard enameled steel box, with trim, frame, door and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames. Provide pipe knockouts.

2.9 SPRINKLER HEADS

Provide automatic sprinklers of type indicated on Drawings, and in accordance with the following listing. Quick response wet type sprinklers with fusible links rated for 74 °C, and with sprinkler head finishes as mentioned below shall be the standard type except as noted in the table below or unless otherwise indicated. The sprinkler shall be installed in the flush position with the element exposed below the ceiling line

2.9.1 Head Categories

2.9.1.1 AUTOMATIC SPRINKLERS TYPE SP-1

for installation in false ceilings, quick response type, decorative style extending less than 25 mm below ceiling with only fusible link, levers and ceiling plate visible. Deflector and retaining parts to be concealed in sprinkler body. Visible parts to be stainless steel and ceiling plate satin finish chrome. Sprinkler body to be high quality bronze. Sprinklers to have 15 mm male thread inlet and a K-factor of 5.6 .

2.9.1.2 AUTOMATIC SPRINKLERS TYPE SP-2:





for exposed installations, quick response upright type of high quality bronze construction. Sprinklers to have 15 mm male thread inlet and a K-factor of 5.6 .

2.9.1.3 AUTOMATIC SPRINKLERS TYPE SP-3:

for transformer rooms, quick response upright type of high quality bronze construction. Sprinklers to have 15 mm male thread inlet and a K-factor of 57 (U.S).

2.9.2 Head Types

- Sprinkler Heads - No false ceiling Areas: Sprinkler heads to be rough bronze finish, of an approved **upright** type, installed in accordance with NFPA Standard No. 13.
- Sprinkler Heads - No false ceiling Areas: Sprinkler heads to be rough bronze finish, of an approved **pendant** type, installed in accordance with NFPA Standard No. 13.
- Sprinkler Heads - Ceiling Areas: Sprinkler heads to be of types in accordance with the following listing:
 1. Pendant Type: Sprinkler heads to be polished chrome plated finish, of an approved pendant type, installed in accordance with NFPA Standard No. 13. The maximum distance from the deflector to finished ceiling shall be 50 mm.
 2. Recessed Type: Sprinkler heads to be new automatic pendent chrome plated sprinkler heads with matching chrome plated recessed cup.
 3. Concealed Type: New automatic concealed sprinkler heads with white finish cover plate.
- Sprinkler Heads - Sidewall: Sidewall sprinkler heads to be chrome plated
- Sprinklers types: Provided sprinklers at the specified locations or as shown on plans. Follow NFP13 in selecting and installing sprinklers.

2.9.3 Temperature Rating

Fusible links shall be for ordinary hazard, except where otherwise indicated.

2.9.4 Spares

Spares shall be furnished for each type of sprinkler head, complete with appropriate storage cabinet and wrench.

2.9.5 Head Protection





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Heads shall be protected with paper or plastic bags during painting operations. Protection shall be removed immediately upon finishing painting operations. Head guards shall be provided wherever mechanical damage could occur. Guard finish shall be red enamel.

2.10 VALVES

2.10.1 Underground

2.10.1.1 Post Indicator Valve Assembly (PIV)

Assembly shall consist of a standard FM-approved or UL-listed inside-screw gate valve with an above-grade post indicator or a completely factory-assembled FM-approved quarter-turn valve and above-grade post indicator-operator. Direction to open shall be counterclockwise.

Quarter-turn valve shall be a wafer-type butterfly valve, rated at 1200 kilopascal, elastomer-lined and sealed. Liner shall act as a gasket between ASME B16.1, Class 125 or Class 250 flanges. Post shall have a fail-safe feature to keep valve intact in case of breaking off above grade. Operator shall be worm-gear type with permanently oil-lubricated watertight gear case complete with handle.

Surfaces below grade shall receive a coating of bitumen not less than 0.508 millimeter thick. Above-grade surfaces shall be filled, primed, and finished with a multiple coat of high-gloss, weather-resistant, red enamel.

Post indicator valves shall be fitted to accommodate electrical supervisory switches.

Electrical supervisory switches shall be provided for interconnection to the building Fire Alarm System. Switches and connections shall meet the requirements of Section 28 31 13.00 40 FIRE DETECTION AND ALARM CONTROL, GUI, AND LOGIC SYSTEMS.

2.10.1.2 Fire-Hydrant Service Valves

Fire-hydrant service valves shall be standard FM-approved or UL-listed inside-screw gate valve, with valve box connection flange.

2.10.1.3 Valve Boxes

Valve boxes shall be not less than 5 millimeter thick cast-iron construction with locking cover that has a cast-in identification legend. Boxes shall be adjustable extension type with screw- or slide-type adjustment. Base flange shall be fitted to the valve flange. Full extended length of box shall be greater than required by depth of cover by not less than 100 millimeter. One valve-operating wrench shall be supplied for each size valve nut. Guide rings shall be provided where operating rods are longer than 2 meter.





2.10.2 Aboveground

Gate, globe, and check valves (all sizes) shall be FM approved or UL listed.

Ball valves, DN50 and under, shall be FM approved, rated 2070 kilopascal, with provisions to wire or lock handle in place where critical alarm function may be isolated.

Butterfly valves, DN150, DN200, and DN250 shall be FM approved, rated 1200 kilopascal, cast-iron bodied wafer type, with elastomer liners and seals. Liners shall act as gasket between standard piping-system flanges. Operator shall be worm-gear type, with permanently lubricated gears, and oil-tight and watertight case, complete with handle and automatic position indication.

2.11 MISCELLANEOUS MATERIALS

2.11.1 Bituminous Coating

Bituminous coating shall be a solvent cutback, heavy-bodied material to produce not less than a 0.305 millimeter dry-film thickness in one coat and shall be as recommended by the conduit manufacturer for compatibility with factory coating and rubber joints.

For previously coal-tar-coated and for uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type, conforming to MIL-C-18480.

2.11.2 Bolting

Flange and general-purpose bolting shall be hex-head and shall conform to ASTM F 568M, Class 4.8 or higher ASTM A 307, Grade B. Heavy hex-nuts shall conform to ASTM A 563M. ASTM A 563. Square-head bolts and nuts are not acceptable.

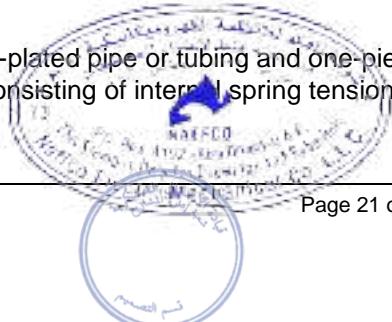
2.11.3 Elastomer Calk

Polysulfide- or polyurethane-base elastomer-calking material shall be two-component type, conforming to ASTM C 920.

2.11.4 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated, except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to ASME A112.18.1.

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing and one-piece or split-pattern type elsewhere. Escutcheons shall have provisions consisting of internal spring tension devices or setscrews to maintain a fixed position against a surface.





2.11.5 Flashing

2.11.5.1 Lead

Sheet lead shall conform to ASTM B 749, and shall weigh not less than 20 kilogram per square meter 4 pounds per square foot.

2.11.5.2 Copper

Sheet copper shall conform to ASTM B 370 and shall weigh not less than 4.88 kilogram per square meter.

2.11.6 Flange Gaskets

Gaskets shall be suitable for the intended use and shall contain no asbestos.

2.11.7 Pipe-Thread Compounds

Tetrafluoroethylene tape or other suitable compounds shall be used.

2.12 2.12 FIRE-PROTECTION SYSTEM IDENTIFICATION

A coordinated system of piping and equipment identification shall be provided which includes the following:

Framed and plastic-protected diagrammatic layout of all piping systems, identifying and locating piping, equipment, and valves. Where existing systems are being modified, existing layouts shall be brought up to date.

Metal-tag-identified major valves, piping-system components, and equipment

Metal identification plate at controlling alarm valve identifying system and area protected

Service-labeled piping

Color coding shall be in accordance with NFPA 291 .

2.12.1 Diagrams

Chart listing of equipment shall be by designation number and shall show pertinent data. Diagrams shall be neat, mechanical drawings mounted in extruded aluminum frames, with 3 millimeter thick acrylic plastic protection. Location shall be as directed by CMW engineer. A minimum of one mounted chart and diagram, plus one extra copy of each, shall be provided for each fire-protection system





2.12.2 Metal Tags

Identification tags made of brass or aluminum and indicating function of valve or similar component, shall be installed on such system devices. Tags shall be not less than 50 millimeter in diameter and marking shall be stamped.

Equipment shall be provided with metal identification tags bearing an equipment designation number matching the drawing or diagram designations.

Tags shall be secured to valve or equipment items with 2.7 millimeter galvanized wire.

2.12.3 Service Labeling

Piping, including that concealed in accessible spaces, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels or tag designations shall be as follows:

SERVICE	LABEL OR TAG DESIGNATION
Main sprinkler supply	MAIN SPRINKLER SUPPLY
Sprinkler riser number	SPRINKLER RISER NO.
Sprinkler branch	SPRINKLER BRANCH
Standpipe piping	STANDPIPE

Piping shall be labeled and arrowed in accordance with the following:

- Each point of entry and exit through walls
- Each change in direction
- In congested or hidden areas, at each point required to clarify service or indicate hazard
- In long straight runs, labels shall be located at a distance visible to each other, but in no case shall the distance between labels exceed 12.2 meter .
- Label lettering shall be 50 millimeter high. Where the size of pipes is 65 millimeter outside diameter and smaller,
- labels shall be attached to 1.6 millimeter aluminum sheet which shall be attached to the pipe with 2.7 millimeter galvanized wire. Labels shall be legible from the primary service and operating area.
- Labels shall be made of self-sticking plastic film designed for permanent installation. Labels shall have red letters on white background.
- Label and valve tag schedule above shall not be construed as defining or limiting the work. All piping systems shall be labelled .

2.13 PAINTING

Equipment of the manufacturer's standard product shall be furnished with the manufacturer's standard finish coat.

Other mechanical equipment shall be furnished with a shop-applied prime paint.





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PART 3 EXECUTION

3.1 GENERAL

Installation of system materials and equipment shall be in accordance with the recommendations and provisions of NFPA 13, NFPA 13E, NFPA 14, and NFPA 24, and UAE Fire and Life Safety code of Practice .Work shall be performed in the presence of CMW Engineer who shall be notified by the Contractor 48 hours in advance of the start of work.

All installation work shall be performed by licensed fire protection sprinkler contractors, Licensed by Civil Defence.

3.2 UNDERGROUND PIPING INSTALLATION

Installation of piping materials shall conform to the written or published instructions of the manufacturer. Pipes passing through walls below grade and ground-floor slab shall pass through pipe sleeves one size larger than pipe and shall be caulked watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.

In fill areas, pipe passing under or through building grade beams shall have a minimum clearance of 100 millimeter in all directions.

Rubber- or elastomer-jointed piping embedded in concrete walls shall have a joint within 150 millimeter of the face of the wall, capable of absorbing movement without leakage.

Piping penetrating earth or concrete grade shall be extended-joint or flange-bolt height plus 150 millimeter above the grade.

Underground piping below supported or suspended slabs shall be supported from the slab with a minimum of two supports per length of pipe. Supports shall be protected with a coating of bitumen.

On excavations near and below building footings, the backfilling material shall consist of 13.8 Megapascal cured-strength concrete poured or pressure-grouted up to the level of the footing.

After piping has been inspected, and not less than 48 hours prior to being lowered into a trench, external surfaces of the piping, valves, valve operators, and valve boxes shall be coated with a compatible bituminous coating suitable for protection against brackish ground water. Application shall be in accordance with the manufacturer's instructions to a dry-film thickness of not less than 0.305 millimeter.

3.2.1 Construction Tolerances for Types CIWP and DIWP

Maximum deviation from design elevation at any point along piping shall not exceed 65 millimeter for all sizes of piping.

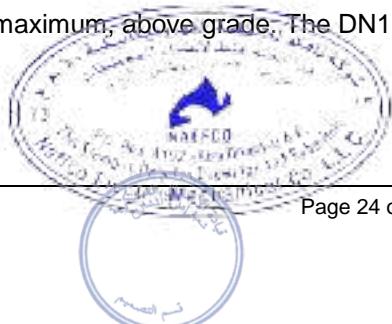
Maximum deviation from line at the end of an 5.5 meter length of piping shall be 65 millimeter and cumulatively shall not exceed 150 millimeter. Corrections from line within preceding tolerances shall be made at a rate not to exceed 65 millimeter for any one length of piping.

Maximum deflection for curves for 5.5 meter lengths of cast ferrous pipe shall be in accordance with NFPA 24.

When the alignment requires deflections in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within established limits, as approved.

3.2.2 Fire Hydrants

Hydrant outlets shall be 600 millimeter, minimum, to 900 millimeter, maximum, above grade. The DN115 outlet shall face the road or area of access.





3.2.3 Valve Boxes

Valves and valve boxes shall be set plumb. Valve boxes shall be centered on the valves. Where feasible, valves shall be located outside traffic areas. Soil shall be carefully tamped around each valve box to a distance of 1.2 meter on all sides of the box or to the undisturbed trench face when less than 1.2 meter.

Class 3000A concrete slabs 600 millimeter square by 100 millimeter thick shall be provided to protect valve boxes.

3.2.4 Thrust Blocks

Thrust blocks shall be provided to absorb hydraulic thrust at caps, plugs, and at system change-of-direction fittings.

Thrust block shall be 20 Megapascal cured-strength concrete placed against undisturbed soil, with an area sufficient to provide load transmittal.

3.3 ABOVEGROUND PIPING-SYSTEMS INSTALLATION

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there will be not less than 13 millimeter of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel shall be arranged to be in line with each other and parallel to the lines of the building.

Load rating for pipe-hanger supports shall be based on all lines filled with water. Deflection per span shall not exceed slope gradient of pipe.

Schedule 40 and heavier ferrous pipe supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing. For concentrated loads such as valves, allowable span shall be reduced proportionately.

PIPE SIZE (DN) (MILLIMETRE)	ROD SIZE (MILLIMETRE)	HANGER SPACING FOR STEEL PIPE (MILLIMETRE)
Up to 25	10	2400
32	10	3600
40	10	4500
65 to 90	10	4500
125	15	4500
100	15	4500
150	15	4500

Vertical risers shall be supported at the base where possible and at intervals specified. Piping shall be guided for lateral stability as necessary. Clamps shall be placed under fittings wherever possible. Carbon-steel pipe shall be supported at each floor at not more than 4.5 meter intervals for pipe DN50 and smaller, and at not more than 6.1 meter intervals for pipe DN65 and larger.





Piping shall be securely supported with allowance for thrust forces and thermal expansion and contraction and shall not be subject to mechanical, chemical, vibrational, or other damage, in conformance with ASME B31.1.

3.4 SOUND STOPPING

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings; into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceiling where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

Sound stopping and vapor-barrier sealing of pipe shafts, and large floor and wall openings may be accomplished by packing with properly supported mineral fiber insulation or by foaming-in-place with self-extinguishing, 0.9 kilogram density polyurethane foam to a depth not less than 150 millimeter. Foam shall be finished with a rasp. Vapor barrier shall be not less than 3 millimeter thickness of vinyl mastic applied to visible and accessible surfaces. Where fire stopping is a consideration, only mineral fiber shall be used, and, in addition, openings shall be covered with 1.6 millimeter sheet metal.

3.5 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry or concrete walls, or floors. Sleeves passing through steel decks shall be continuously welded or brazed to the deck.

Sleeves extending through floors, roofs, or load-bearing walls, and sleeves through fire barriers shall be continuous and fabricated from Schedule 40 steel pipe with welded anchor lugs. Other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable.

Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve, and additionally shall provide a minimum 10 millimeter clearance. Sleeve shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and generation of noise.

Space between a pipe and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with mineral fiber conforming to ASTM C 592 wherever the piping passes through firewalls, equipment-room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction-surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction-surface penetration shall be filled with an elastomer caulk to a depth of 15 millimeter. Surfaces to be caulked shall be oil- and grease-free.

Exterior wall sleeves shall be caulked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

3.6 ESCUTCHEONS

Escutcheons shall be provided at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. Escutcheons shall be chrome plated in occupied spaces and shall conceal openings in building construction. Escutcheons shall be firmly attached.

3.7 FLASHINGS

Flashings at systems penetrations of building boundaries shall be provided as indicated.





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3.8 BRANCH-LINE TESTERS

Branch-line testers shall permit testing and flushing lines without shutdown of system or loss of fire-protection capability. Line testers shall be fitted with chain-attached caps. Line testers shall be installed where indicated and on most remote branch lines being served by cross mains, so that testing may be accomplished at the dead corners of each sprinkler system.

3.9 PAINTING

Manufacturer's standard-finish equipment surfaces damaged during construction shall be brought to as-new condition by touchup or repainting to the satisfaction of CMW Engineer, or replaced with new undamaged equipment at no additional cost to CMW.

Pipe hangers, supports, and other iron work in concealed spaces shall be thoroughly cleaned and painted with one coat of primer paint.

All fire piping, valves, and appurtenances, including hose racks and reels, but excluding hoses, hose nozzles and siamese connections, shall receive two coats of enamel, color No. 11105 (red) in accordance with MIL-STD-101 and FED-STD-595.

3.10 ELECTRICAL WORK

Electrical work is specified in Division 16, "Electrical," except for control and fire alarm wiring which shall be provided under this section in accordance with NFPA 70. Rigid metal conduit or intermediate metal conduit shall be used, except that electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

Motors, controllers, contactors, and disconnects shall be furnished with their respective pieces of equipment, except that controllers indicated as part of the motor control centers shall be provided under Section 26 24 19.00 40 MOTOR-CONTROL CENTERS. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Controllers and contactors shall have maximum 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment are furnished larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

3.11 SYSTEM TESTING

Prior to acceptance of the work, completed systems shall be tested in the presence of CMW Engineer. Upon approval, certificates of testing shall be provided.

Tests shall be hydrostatic, unless otherwise specified. Only potable water shall be used for testing.

Air Tests, Valve-Operating Tests, and Drainage Tests shall be performed for dry-pipe systems.

Full-flow System Operating Tests shall be performed for standpipe systems.

Contractor will supply testing water, the Contractor shall be responsible for approved disposal of contaminated water.

Contractor shall prepare and maintain test records of piping-system tests.

Records shall show personnel responsibilities, dates, test-gage identification numbers, ambient and test-water temperatures, pressure ranges, rates of pressure drops, and leakage rates. Each test acceptance shall require the signature of the Contracting Officer.

3.11.1 Test Gages

Test gages, to be acceptable, shall have 115 millimeter dials or larger with accuracy of plus or minus 1/2 of 1 percent of full-scale range and dial graduations and pointer width compatible with readability to within one-half of the accuracy extremes. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting position at midpoint of the dial or within the middle third of the scale range. Certification of accuracy and correction table shall bear a date within 90 calendar days prior to the test, test gage number, and the project number.





3.11.2 Pneumatic Testing

Pressure Tests shall be pneumatic when freezing conditions may occur and upon prior approval by CMW Engineer. Compressed air used for testing shall be oil-free.

Pneumatic testing shall include swabbing all joints under a test pressure of 34 kilopascal with a standard high film strength soap solution and observing for bubbles.

Duration of the test will be determined by CMW Engineer and will be for 2 hours, minimum, to 24 hours, maximum. Test may be terminated by direction of CMW Engineer at any point during this period after it has been determined that the permissible leakage rate has not been exceeded.

3.11.3 Test and Acceptable Criteria

Aboveground systems shall have Pressure Tests at 1380 kilopascal and the applied pressure shall be maintained without further addition of test media for not less than 2 hours. Maximum allowable pressure drop shall be 14 kilopascal .

Underground rubber-jointed ferrous-pipe water systems shall be tested at 1380 kilopascal, and the applied test pressure shall be maintained for not less than 2 hours. Maximum allowable pressure drop shall be 14 kilopascal. After satisfactory hydrostatic testing, piping shall be tested for leakage as follows:

- Duration of each leakage test shall be not less than 2 hours; during the test, the main shall be subjected to 200 psi pressure based on the elevation of the lowest section under test and corrected to the elevation of the test gage.
- Leakage shall be defined as the quantity of water supplied into the laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
- No piping installation will be accepted if the leakage in gallons per hour exceeds 2.04 times the number of joints in the length of the pipe line tested times the nominal diameter of the pipe in inches times the square root of the average test pressure expressed as psig. Amount of leakage at the joints shall not exceed 1.89 litre per 100 joints regardless of pipe diameter.
- Hydrostatic tests shall be applied to piping with concrete thrust blocking only after the concrete has cured for more than 7 calendar days.

Backflow prevention into connected potable-water systems and system devices shall be tested for proper functioning under conditions normal to their application.

Dripping or weeping joints shall be repaired.

3.12 DISINFECTION

Water piping, including valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Solution shall be held for a period of not less than 8 hours, at which time the solution shall contain a minimum residue of 2 ppm of available chlorine or the system shall be re-disinfected. After successful disinfection the piping shall be thoroughly flushed before placing into service. Water for disinfection, and flushing will be furnished by the Government.

3.13 CLEANING AND ADJUSTING

At the completion of the work, all parts of the installation shall be thoroughly cleaned. Equipment, pipes, valves, and fittings shall be cleaned of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system. Automatic control devices shall be adjusted for proper operation.

-- End of Section --





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FIRE FOAM EXTINGUISHING FOR AIRCRAFT HANGERS

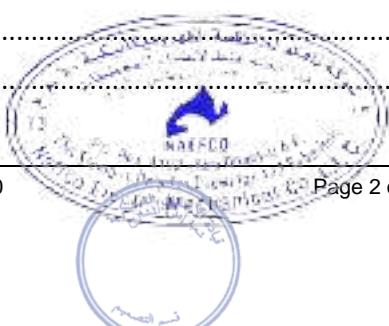
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - a. AWWA C500 (2009) Metal-Seated Gate Valves for Water Supply Service
 - b. AWWA C651 (2005; Errata 2005) Standard for Disinfecting Water Mains
2. ASTM INTERNATIONAL (ASTM)
 - a. ASTM A 53/A 53M (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. FM GLOBAL (FM)
 - a. FM P7825 (2009) Approval Guide
4. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)
 - a. FCCCHR List (continuously updated) List of Approved Backflow Prevention Assemblies
5. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - a. NFPA 11 (2005; Amendment 1 2006; Amendment 2 2007) Low-, Medium- and High- Expansion Foam Systems
 - b. NFPA 13 (2010) Installation of Sprinkler Systems
 - c. NFPA 14 (2010) Standard for the Installation of Standpipe, Private Hydrants and Hose Systems
 - d. NFPA 15 (2006) Water Spray Fixed Systems for Fire Protection
 - e. NFPA 16 (2006) Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
 - f. NFPA 24 (2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
 - g. NFPA 30 (2007; Errata 2008) Flammable and Combustible Liquids Code
 - h. NFPA 409 (2004; TIA 2005; TIA 2006) Standard on Aircraft Hangars
 - i. NFPA 70 (2008; AMD 1 2008) National Electrical Code - 2008 Edition





j. NFPA 72 (2010) National Fire Alarm Code

6. THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

- a. SSPC Paint 22 (1982; E 2004) Paint Specification No. 22 Epoxy-Polyamide Paints (Primer, Intermediate, and Topcoat)
- b. SSPC Paint 25 (1997; E 2004) Paint Specification No. 25 Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel Type I and Type II
- c. SSPC SP 11 (1987; E 2004) Power Tool Cleaning to Bare Metal
- d. SSPC SP 3 (2004; E 2004) Power Tool Cleaning
- e. SSPC SP 6 (2007) Commercial Blast Cleaning

7. U.S. DEPARTMENT OF DEFENSE (DOD)

- a. MIL-DTL-24441 (Rev D) Paint, Epoxy-Polyamide
- b. MIL-F-24385 (Rev F; Am 1) Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater

8. U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- a. FS A-A-2962 (Rev J) Enamel, Alkyd, Gloss, Low VOC Content
- b. FS A-A-58092 (Basic) Tape, Antiseize, Polytetrafluoroethylene
- c. FS WW-S-2739 (Basic) Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam

9. UNDERWRITERS LABORATORIES (UL)

- a. UL 262 (2004) Standard for Gate Valves for Fire-Protection Service
- b. UL 789 (2004; Rev thru Aug 2008) Indicator Posts for Fire-Protection Service
- c. UL Fire Prot Dir (2009) Fire Protection Equipment Directory

10. UAE Fire and Life Safety Code of Practice

1.2 SYSTEM DESCRIPTION

1.2.1 Design Requirements

Design, provide new, install and commission automatic aqueous film forming foam (AFFF) deluge pre-action sprinkler system and under-wing supplemental protection system. System shall provide uniform distribution of AFFF solution to provide complete coverage throughout the areas indicated. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 11, NFPA 13, NFPA 14, NFPA 15, NFPA 16, NFPA 24, NFPA 30, NFPA



70, NFPA 72, and NFPA 409, (whichever applicable for the specific project), Each system [shall be designed for earthquakes and] shall include all materials, accessories and equipment necessary to provide each system complete and ready for use. Design and install each system to give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to provide complete coverage in accordance with the drawings to be submitted for approval. Devices and equipment for fire protection service shall be of a make and type listed by the Underwriter's Laboratories Inc. in the UL Fire Prot Dir, or approved by the Factory Mutual System and listed in FM P7825. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Command of Military Works (CMW) and its clients.

1.2.1.1 Calculations

Submit design calculations for the system.

- a. Hydraulic calculations showing basis for design in accordance with NFPA 11 and NFPA 13.
- b. Pressure discharge graphs or tables showing pressure discharge relationship for sprinkler heads and discharge nozzles.
- c. Substantiating battery standby power requirements calculations showing battery capacity, supervisory and alarm power requirements.
- d. System surge analysis showing surge pressure occurring throughout the system at both design flow and nonflow conditions.

1.2.1.2 AFFF Containment and Disposal Plan

Submit AFFF containment and disposal plan as required under paragraph entitled "Environmental Protection."

1.2.2 System Operation

Flow of water and AFFF shall be controlled by deluge pre-action valves. Foam proportioning equipment shall activate automatically upon tripping of the valve(s) for the corresponding foam system(s). [Deluge], [Pre-action] valves shall be tripped by independent detection systems. No valve will be operated by the building fire evacuation alarm system. Use of motor-operated valves is prohibited. Once activated, system(s) shall operate until shut down manually. Provide separate circuits from the control panel to each zone of initiating devices. Transmission of signals from more than one zone over a common circuit is prohibited.

1.2.2.1 Overhead Systems

Overhead systems shall be controlled by [deluge], [pre-action] valves operated by automatic detection systems and by remote manual release stations.





1.2.2.2 Monitor System

Monitor nozzles shall be controlled by deluge valves operated by flow of AFFF solution in the overhead system.

1.2.2.3 Hose System

Hose reels shall be controlled by deluge valves operated by remote manual release stations, separate from those used for overhead systems and monitor nozzles.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

A. SD-02 Shop Drawings

1. Installation Requirements

Prepare shop drawings for fire extinguishing system in accordance with the requirements for "Plans" as specified in NFPA 11 and "Working Plans" as specified in NFPA 13.

Do not commence work until the design of each system and the various components have been approved. Show:

- a. Room, space or area layout and include data essential to the proper installation of each system
- b. Sprinkler heads, discharge nozzles and system piping layout annotated with reference points for design calculations
- c. Field wiring diagrams showing locations of devices and points of connection and terminals used for all electrical field connections in the system, with wiring color code scheme

2. As-Built Drawings

As-built drawings, as specified.

3. Piping Layout and Sensing piping Arrangement

4. Pump Room

B. SD-03 Product Data

1. Equipment data

- Pipe, fittings, and mechanical couplings
- [Deluge] and/or [Pre-action] valves
- Valves, including gate, check, and globe
- Water motor alarms
- Sprinkler heads





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- Monitor nozzles
- Hose and nozzles
- Pipe hangers and supports
- Pressure switch
- Fire department inlet connections
- Tank mounted air compressor
- Air pressure regulating device
- Air compressor pneumatic detection system
- Low air pressure trouble alarm
- Detection devices
- Storage batteries
- Alarm bells
- Alarm horns
- Annunciator panel
- Foam hydrants
- AFFF concentrate storage tanks
- Proportioning equipment
- AFFF concentrate
- Strainers
- Manual release stations
- Backflow preventers
- Control panel
- Battery charger

Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide.

Submit only originals. Photocopies will not be accepted. Partial submittals will not be accepted.

2. Spare Parts

Spare parts data for each different item of material and equipment specified .

C. SD-05 Design Data

- Hydraulic calculations
- Pressure discharge graphs or tables
- Battery standby power requirements calculation
- System surge analysis

D. SD-06 Test Reports

1. Preliminary Tests

Three copies of the completed Preliminary Tests Reports, no later than 5 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist and by the Manufacturer's Representative.

2. Final Test





Three copies of the completed final test Reports , no later than 5 days after the completion of the tests. All items in the reports shall be signed by the Fire Protection Specialist and the Manufacturer's Representative. Test reports in booklet form showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches. The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report.

E. SD-07 Certificates

1. Fire Protection Specialist

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the fire fighting installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

2. Qualifications of Welders

3. Qualifications of Installer

Certificates of qualifications, as specified .

4. Preliminary and Final Test Certification

Request for formal inspection and tests, as specified

5. Certificate of origin

6. Certificate of unconditioned 5 years warranty

F. SD-10 Operation and Maintenance Data

- [Deluge]and/or [Pre-action] valves
- Tank mounted air compressor
- Proportioning equipment
- Control panel
- AFFF concentrate storage tanks
- Monitor nozzles
- Instructions for operating the fire extinguishing system

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Furnish one complete set of data prior to the time that final acceptance tests are performed, and furnish the remaining sets before the contract is completed.(total of four copies of each data package)

1.4 QUALITY ASSURANCE





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1.4.1 Fire Protection Specialist

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be specialized subcontractor who is certified by UAE Civil Defence in the Automatic Sprinkler System design, studies, erection, installation, operating, maintaining, testing and commissioning. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least five systems that have performed in the manner intended for a period of not less than 6 months.[Submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.]

1.4.2 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; certifications shall not be more than one year old.

1.4.3 Qualifications of Installer

Prior to installation, submit data for approval showing that the Contractor has successfully installed automatic foam fire extinguishing sprinkler systems and associated equipment of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least three installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

1.4.4 Preliminary Test Certification

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall be either capped or plugged until installed.





PART 2 PRODUCTS

2.1 DESIGN OF FOAM SYSTEMS

Design of [deluge] and/or [pre-action] fire extinguishing foam systems shall be by hydraulic calculations for uniform distribution of AFFF solution over the protected area and shall conform to the NFPA standards listed above and to the requirements as specified herein.

2.1.1 Sprinkler Heads

Heads shall have 15 or 13.50 mm orifice. No o-rings will be permitted in sprinkler heads. [For deluge systems, provide open heads. [For pre-action systems, the release element of each head shall be of the "high" temperature rating or higher as suitable for the individual location installed.] Provide chromium plated ceiling plates and pendent sprinklers below suspended ceilings. Provide corrosion resistant sprinkler heads and sprinkler head guards as required by NFPA 13.

2.1.2 Cabinet

Provide extra sprinkler heads and sprinkler head wrench in a metal cabinet adjacent to the pre-action valve within each building. The number and types of extra sprinkler heads shall be as specified in NFPA 13.

2.1.3 [Deluge] and /or [Pre-Action] Valves

Valves shall be operated by a detection system listed for releasing service and independent of the building fire alarm system. [[Deluge] [Pre-action] valve clappers shall incorporate a latching mechanism that will not be affected by changes of pressure in the water system.] If 150 mm valves are used in 200 mm risers, provide smoothly tapered connections. In addition to automatic operation, arrange each valve for manual release at the valve. Provide pressure gages and other appurtenances at the [deluge] [pre-action] valves as required by NFPA 13.

Provide a detection device at the end of each actuation circuit to test the circuit and mount the device between 1.80 and 2.40 meters above the finish floor. Label each testing device to indicate the valve it activates

2.1.4 AFFF Solution Distribution

2.1.4.1 For pre-action systems

Distribution shall be essentially uniform throughout the area in which it is assumed the sprinkler heads will open. Variation in discharge from individual heads in the hydraulically most remote area shall be between 100 and 115 percent of the specified density .

2.1.4.2 For deluge systems

Distribution shall be essentially uniform throughout the area. Variation in discharge from individual heads shall be between 100 and 115 percent of the specified density.





2.1.5 AFFF Solution Application Density

Size system to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the ceiling sprinklers shall be 110 mL/sec per sq meter with simultaneous operation of foam monitor nozzles, and foam hose lines as instructed.

2.1.6 Sprinkler Discharge Area

2.1.6.1 For pre-action systems

Area shall be as defined by NFPA 13

2.1.6.2 For deluge systems

Area shall be as determined in accordance with NFPA 409 for Type I aircraft hangars

2.1.7 Friction Losses

Calculate losses in pipe in accordance with the Hazen-Williams Formula with 'C' value of 100 for steel pipe [except 120 for steel pipe used in deluge systems], 150 for copper tube, and 140 for cement lined ductile iron pipe .

2.1.8 Location of Sprinkler Heads

Location of heads in relation to the ceiling and spacing of sprinkler heads shall conform to NFPA 13 for extra hazard occupancy. The spacing of sprinklers on the branch lines shall be essentially uniform .

2.1.9 Duration of Discharge

System shall apply foam solution over the sprinkler discharge area for a minimum of [10] minutes while simultaneously discharging foam solution through monitors for a minimum of [10] minutes. Hose station discharge time shall be a minimum of [20minutes]. Reduction of the discharge duration based on a discharge rate higher than the specified minimum is not permitted.

2.2 ELECTRIC DETECTION DEVICES

Provide electric heat detectors, and smoke detectors, and combination ultraviolet-infrared detectors. All wiring shall be supervised and installed in protective metal conduit or tubing.





2.2.1 Control Panel

Modular type panel installed in a surface mounted steel cabinet with hinged door and cylinder lock. Switches and other controls shall not be accessible without the use of a key. The control panel shall be a neat, compact, factory-wired assembly containing all parts and equipment required to provide specified operating and supervisory functions of the system.

Panel cabinet shall be finished on the inside and outside with factory-applied enamel finish. Provide main annunciator located on the exterior of the cabinet door or visible through the cabinet door. Provide audible trouble signal. Provide prominent engraved rigid plastic or metal identification plates, or silk-screened labels attached to the rear face of the panel viewing window, for all lamps and switches. System power shall be 120 volts AC service, transformed through a two winding isolation transformer and rectified to 24 volts DC for operation of all system initiating, actuating, signal sounding, trouble signal and fire alarm tripping circuits. System shall be electrically supervised on all circuits. A single open or ground fault condition in any detection (initiating) or signaling circuit shall not result in any loss of system function, but shall cause the actuation of system trouble signals. A ground fault condition or single break in any other circuit shall result in the activation of the system trouble signals. Loss of AC power, a break in the standby battery power circuits, or abnormal AC power or low battery voltage shall result in the operation of the system trouble signals. The abnormal position of any system switch in the control panel shall result in the operation of the system trouble signals. Trouble signals shall operate continuously until the system has been restored to normal at the control panel. System trouble shall also be annunciated on the appropriate zone of the building fire alarm panel. Provide a 100 mm remote system trouble bell [or buzzer], installed in a constantly attended area, arranged to operate in conjunction with the integral trouble signals of the panel. Provide remote bell [or buzzer] with a rigid plastic or metal identification sign which reads in English and Arabic "Foam System Trouble." Lettering on identification sign shall be a minimum of 25 mm high. Control panel, batteries, and battery charger shall be weatherproof type or located in an area not subject to water damage. System control panel shall be UL listed or FM approved for extinguishing system control (releasing device service). Permanently label all switches. Provide panel with the following switches:

- a. Trouble silencing switch which transfers audible trouble signals (including remote trouble devices, if provided) to an indicating lamp. Upon correction of the trouble condition, audible signals will again sound until the switch is returned to its normal position, or the trouble signal circuit shall be automatically restored to normal upon correction of the trouble condition. The silencing switch may be a momentary action, self-resetting type.
- b. Alarm silencing switch which when activated will silence all associated alarm devices without resetting the panel, and cause operation of system trouble signals.
- c. Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of the system and zone trouble signals.
- d. Reset switch which when activated will restore the system to normal standby status after the cause of the alarm has been corrected, and all activated initiating devices reset. [Operation of reset switch shall restore activated smoke detectors to normal standby status.]
- e. Lamp test switch.
- f. City disconnect switch which when activated will disconnect the coded device and cause operation of the system trouble signal.

2.2.1.1 Main Annunciator





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Provide integral with the main control panel. Provide separate alarm and trouble lamps for each zone alarm initiating circuit as indicated below, located on the exterior of the cabinet door or visible through the cabinet door. Lamps shall be LED (Light Emitting Diode) type. Supervision will not be required provided a fault in the annunciator circuits results only in loss of annunciation and will not affect the normal functional operation of the remainder of the system. Each lamp shall provide specific identification of the [zone] [area] [device] by means of a permanent label. In no case shall zone identification consist of the words "Zone 1," "Zone 2," etc., but shall consist of the description of the [zone] [area] [device].

2.2.1.2 Initiating Zones

List zones from 1 to x, with a brief description of each zone; e.g. "Zone 1: Hangar Bay No. 1". Expand this list as necessary to identify all the zones required for the building.

Initiating Zones Shall be arranged as follows:

Zone 1: [_____]

Zone 2: [_____]

Zone 3: [_____]

Zone x: [_____]

2.2.1.3 Remote Annunciator Panel

Locate as shown. Panel shall duplicate all requirements specified for the main control panel annunciator, except that in lieu of individual zone trouble lamps a single common system trouble lamp may be provided. Lamps shall be LED (Light Emitting Diode) type, except lamps used in backlit panels shall be LED or neon type. Panel shall have a lamp test switch.

Zone identification shall be by means of silk-screened labels attached to the reverse face of backlit viewing window(s). Panel shall be of the weatherproof type, surface -mounted.

2.2.2 Auxiliary Power Supply

2.2.2.1 Storage Batteries

Provide [sealed lead calcium,] [or] [sealed lead acid,] [or] [vented wet cell nickel cadmium,] batteries and charger. Drycell batteries are not acceptable. House batteries in the control panel or in a well constructed vented steel cabinet with cylinder lock, non-corrosive base, and louvered vents. Provide batteries of adequate ampere-hour rating to operate the system under supervisory conditions for 60 hours, at the end of which time batteries shall be capable of operating the entire system in a full alarm condition for not less than [30] minutes. Provide calculations substantiating the battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts. Provide batteries with post-and-nut, "L"-blade, or similar terminals. Slip-on tab type terminals are not acceptable. When a separate battery cabinet is used, provide a fuse block for battery leads within the cabinets.

Finish the cabinet on the inside and outside with enamel paint. Locate the top of the battery cabinet not more than 1.20 meters above floor level.

2.2.2.2 Battery Charger





Provide completely automatic high/low charging rate type charger capable of recovery of the batteries from full discharge to full charge in 24 hours or less. Provide an ammeter for recording rate of charge and a voltmeter to indicate the state of battery charge under load. Meters shall be factory installed, or factory-supplied plug-in modules. Field installation of meters other than the panel manufacturer's plug-in modules is prohibited.

Provide a trouble light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided. House charger in the control panel or battery cabinet.

2.3 PNEUMATIC DETECTION SYSTEM

Provide pneumatic single acting rate-of-rise heat detectors. All tubing shall be supervised and installed in protective metal conduit or tubing.

2.3.1 Air Compressor

Shall be automatic, electric motor driven and include piping, pressure switch, regulator, and tank if required. Provide compressor with a minimum capacity capable of charging the pneumatic detection system to normal system pressure in 15 minutes and shall include all controls necessary to maintain the system fully charged.

2.3.2 Piping and Control Panel

Provide copper piping. Provide a control panel or equivalent device(s) to automatically maintain the required pneumatic pressure in the detection system, and limit the quantity of air that enters the detection/release system. Provide supply air and system air pressure gages.

2.4 PIPING SUPERVISION

[Pre-action sprinkler piping] [and] [pneumatic detection system] shall be supervised. A break in the piping or tubing systems resulting in loss of pneumatic pressure shall result in the activation of a trouble signal.

Provide a silencing switch which transfers trouble signals to an indicating lamp and arrange so that correction of the trouble condition will automatically transfer the trouble signal from the indicating lamp back to the trouble signal until the switch is restored to normal position.

2.5 MANUAL RELEASE STATIONS

Provide [combined] overhead system, and monitor nozzle release stations where shown, and separate hose station release stations at each hose station. Stations shall be of a type not subject to operation by jarring or vibration. Stations shall have a dual action release configuration to prevent accidental system discharge. Break-glass-front stations are not permitted; however a pull lever break-glass-rod type is acceptable. Station color shall be red. Station shall provide positive visible indication of operation. Restoration shall require use of a key or special tool. Place warning signs at each station indicating that operation of the station will cause immediate AFFF discharge. Where a building fire alarm pull station is also mounted in the vicinity of a foam release station, separate the stations by at least one meter horizontally. Provided permanent engraved rigid plastic or metal labels to clearly distinguish foam release stations from building fire alarm stations, and to indicate the function of each foam release station. Stations shall be weatherproof type.



2.6 HEAT DETECTORS

Designed for detection of fire by [combination fixed temperature rate-of-rise] or [rate compensating] principle. Locate detectors in accordance with their listing by UL or FM and the requirements of NFPA 72, except provide at least two detectors in all rooms of 56 square meters or larger in area.

Temperature rating of detectors shall be in accordance with NFPA 72. Reduce heat detector spacing in areas with ceiling heights exceeding 3 meters , in accordance with NFPA 72. No detector shall be located closer than 305 mm to any part of any lighting fixture nor closer than 610 mm to any part of an air supply diffuser. Detectors, located in hazardous locations as defined by NFPA 70, shall be types approved for such locations. Provide with terminal screw type connections. Removal of detector head from its base shall cause activation of system trouble signal. Detectors shall be weatherproof type.

2.6.1 Combination Fixed Temperature Rate-of-Rise Detectors

Designed for surface outlet box mounting and supported independently of conduit, tubing or wiring connections. Contacts shall be self-resetting after response to rate-of-rise actuation. Operation under fixed temperature actuation shall result in an external indication.

Detector units located in areas subject to abnormal temperature changes shall operate on fixed temperature principle only.

2.6.2 Rate Compensating Detector

Designed for surface outlet box mounting and supported independently of conduit, tubing or wiring connections. Detectors shall be hermetically sealed and automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise. Detector operation shall not be subject to thermal time lag.

2.7 OPEN-AREA (SPOT-TYPE) SMOKE DETECTORS

Designed for detection of abnormal smoke densities by the [ionization] [or] [photoelectric] principle. Provide necessary control and power modules required for operation integral with the main control panel. Provide detectors and associated modules which are compatible with the main control panel and suitable for use in a supervised circuit. Detector circuits shall be of the 4 wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Provide a separate, fused, power circuit for each smoke detection initiating circuit (zone). Failure of the power circuit shall be indicated as a trouble condition on the corresponding initiating circuit.

Malfunction of the electrical circuits to the detector or its control or power units shall result in the operation of the system trouble signals. Equip each detector with a visible indicator lamp that flashes when the detector is in the normal standby mode and glows continuously when the detector is activated.

Provide plug-in type detectors with tab-lock or twist-lock, quick disconnect head and separate base in which the detector base contains screw terminals for making all wiring connections. Detector head shall be removable from its base without disconnecting any wires. Removal of detector head from its base shall cause activation of system trouble signals. Provide each detector with an integral screen to prevent entrance of insects into the detection chamber(s).

2.7.1 Ionization Detectors





Multiple chamber type which is responsive to both visible and invisible particles of combustion. Detectors shall not be susceptible to operation by changes in relative humidity.

2.7.2 Photoelectric Detectors

Operate on a multiple cell concept using an infra-red light-emitting diode (LED) light source .

2.7.3 Detector Spacing and Location

should be as per NFPA 72, the manufacturer's recommendations and the requirements stated herein, however, in no case shall spacing exceed 9 by 9 meters per detector, and 9 lineal meter per detector along corridors. Detectors shall not be placed closer than [1.50] meter from any air discharge or return grille, nor closer than 305 mm to any part of any lighting fixture .

2.8 COMBINATION ULTRAVIOLET-INFRARED FLAME DETECTORS

Flame detectors shall operate on the dual spectrum ultraviolet-infrared (UV-IR) principle. Detector shall employ a solar-blind UV sensor with a high signal-to-noise ratio, and a narrow band IR sensor. Detector logic shall require UV and IR signals to be present, in the proper ratio or signature as emitted by a hydrocarbon fire, before the detector initiates an alarm. Detectors shall respond within 5 seconds to a JP-4 fire 3 meters square, 46 meters from the detector. Detector shall not be activated by non-fire sources such as continuous or intermittent direct or reflected solar radiation, arc-welding, lightning, radiant heat, x-rays, artificial lighting, radio transmissions, and normal jet engine functions. Detector shall have an automatic through-the-lens self-testing feature.

Malfunction of the detector circuitry, or degradation of the sensors' lens cleanliness to the point where the detector will not detect the design fire signature, shall cause operation of the system trouble signals. Logic circuits necessary for operation of the detector shall be integral to the detector or located in separate flame detector control panel(s) located adjacent to the foam system control panel(s). Each detector in alarm shall be individually annunciated by an LED on the detector or at the detector control panel. Primary and auxiliary power supply shall be taken from the foam system control panel(s).

Detectors, and associated control panels if required, shall be compatible with the foam system control panel(s).

Detectors and associated control panels shall be weatherproof, or housed in weatherproof enclosure(s) when in an area subject to system discharge and shall also be explosion-proof when located in hazardous areas as defined by NFPA 70. Detector spacing and location shall be in accordance with NFPA 72, their UL listing or FM approval, and the manufacturer's recommendations.

The detector manufacturer shall determine or approve the detector layout. Detector layout drawings shall include horizontal and vertical angles for correct aiming. Locate detectors so that every portion of the protected area is within the field of view of at least three detectors, taking into account fixed obstructions. Provide detectors with manufacturer's swivel mounting bracket. Provide a permanent engraved rigid plastic or metal label at each detector location with detector aiming information (degrees horizontal and vertical) for the corresponding detector.

2.9 ELECTRICAL WORK

Electrical work is specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control wiring. Fire alarm system is specified in Section [28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM



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2.9.1 Wiring

Provide control wiring and connections to fire alarm systems, under this section and conforming to NFPA 70 and NFPA 72. Wire for 120 volt circuits shall be No. 12 AWG minimum solid conductor. Wire for low voltage DC circuits shall be No. [14] [16] AWG minimum solid conductor [, except wire to remote annunciators, if provided, may be 18 AWG minimum solid conductor]. All wiring shall be color coded. Wiring, conduit and devices exposed to water or foam discharge shall be weatherproof. Wiring, conduit and devices located in hazardous atmospheres, as defined by NFPA 70, shall be explosion proof. All conduit shall be minimum 20 mm .

2.9.2 Operating Power

Power shall be 120 volts AC service, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all signal initiating, signal sounding, trouble signal, and actuating (releasing) circuits. Provide secondary DC power supply for operation of system in the event of failure of the AC supply. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm. Obtain AC operating power for control panel, [and] battery charger [, and air compressor] from the line side of the incoming building power source ahead of all building services. Provide independent properly fused safety switch, with provisions for locking the cover and operating handle in the "POWER ON" position for these connections and locate adjacent to the main distribution panel. Paint switch box red and suitably identify by a lettered designation.

2.9.3 Conductor Identification

Identify circuit conductors within each enclosure where a tap, splice or termination is made. Identify conductors by plastic coated self sticking printed markers or by heat-shrink type sleeves. Attach the markers in a manner that will not permit accidental detachment. Properly identify control circuit terminations.

2.10 SYSTEM ACTIVATION

2.10.1 Overhead System Activation

Provide one or more risers per hangar bay as required by NFPA 409 based on size of bay. Overhead systems, monitor systems and hose systems shall be served by separate risers. Each zone shall encompass of one hangarbay. Upon activation of the detection system or overhead system manual release station(s), the corresponding overhead system protecting that area shall activate .

2.10.2 Monitor System Activation

Overhead systems, monitor systems and hose systems shall be served by separate risers. Each zone shall encompass one hangar bay. Upon activation of detectors and /or two UV-IR detectors for more than 5 seconds or activation of a manual release station, all monitors in that zone shall be activated.

2.10.3 Hose System Activation





Each zone shall encompass the hose stations indicated . Hose stations shall be activated upon activation of a hose station manual release station. Provide a manual release station at each hose station.

2.11 ALARMS

2.11.1 Water Motor Alarms

Provide weatherproof and guarded type alarm for each group of deluge and pre-action valve(s). Alarms shall sound locally on the flow of foam solution in each system to which it is connected. Mount alarms on the outside of the outer walls of each building, at locations indicated. When more than one alarm gong is provided, provide permanent engraved rigid plastic or metal signs indicating to which system each gong is connected.

2.11.2 Local Alarm

Provide electric [alarm bells] to sound locally on operation of any system, regardless of whether water flows or not. When more than one alarm is provided, provide permanent engraved rigid plastic or metal signs indicating to which system each alarm is connected.

2.11.3 Fire Alarm

Provide equipment for the automatic transmittal of an alarm over the building fire alarm system. Arrange so that the detection system and the flow of solution in each system will actuate the alarm. [Activation of a single UV-IR detector shall not cause activation of the foam system but shall cause activation of the fire alarm system].

2.11.3.1 Pressure Switch

Provide switch with SPDT contacts to automatically transmit alarms upon flow of water or AFFF. Alarm actuating device shall have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and shall instantly recycle .

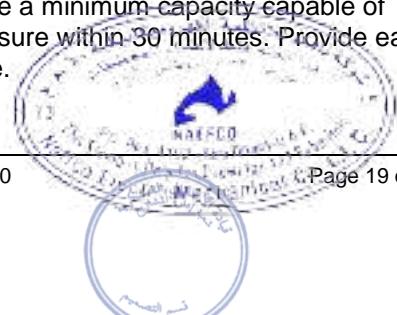
2.11.4 Trouble Alarm

Provide local electric alarm to indicate trouble or failure of the detection system or pre-action sprinkler piping system. Also connect trouble alarm into the building fire alarm control panel to indicate "trouble" on a separate zone labeled "Foam System Trouble".

2.12 TANK MOUNTED AIR COMPRESSOR

Include for projects involving pre-action sprinkler piping systems only.

Provide an approved automatic type electric motor driven air compressor including pressure switch, air piping, and 38 liter minimum capacity tank. Compressor shall have a minimum capacity capable of charging the complete sprinkler system to normal system air pressure within 30 minutes. Provide each system with an approved automatic air pressure regulating device.





2.13 AFFF CONCENTRATE

To be as per MIL-F-24385 ,

2.13.1 Concentrate Fill Pump

Provide one pump to fill foam system tank. Pump shall have a minimum flow rate of 27 L/m . Pump shall be complete with 115 VAC motor, fused switch, power cord with plug and 3 meters 10 foot minimum suction and clear discharge hoses.

2.14 DIAPHRAGM PRESSURE PROPORTIONING EQUIPMENT

Foam solution shall be produced by introducing AFFF concentrate into the water stream by the balanced pressure proportioning method using a diaphragm pressure tank and ratio controller.

2.14.1 Diaphragm Pressure Proportioning Tanks

Tanks shall be cylindrical steel ASME pressure vessels with a full Buna-N impregnated nylon inner tank or bladder designed to contain AFFF concentrate and to be used in conjunction with the concentrate ratio controller. Tanks shall be designed for working pressure of 1206 kPa(gage) and hydrostatically tested at 1.5 times the working pressure in accordance with ASME standards at the factory. Tanks shall have UL or FM label and ASME stamp affixed to the vessel. Size tank to provide sufficient AFFF concentrate for the time specified when the system is discharging foam solution at total maximum system flow. Also provide connected reserve tank(s) of equal capacity. Permanently label each tank with its capacity, type and percentage of concentrate, which system(s) it serves, and whether it is a main or reserve tank. Conspicuously post filling instructions near each group of tanks. Provide a gage or unbreakable sight glass to permit visual determination of level of tank contents. Prior to shop painting, abrasive blast clean tank exterior surface in accordance with SSPC SP 6 to a surface profile not to exceed 0.05 mm and provide a MIL-DTL-24441 or SSPC coating system to the tank exterior. Prime tank exterior with one coat of MIL-DTL-24441/1, Formula 150 or SSPC Paint 22 primer applied to a dry film thickness of 0.076 mm and topcoat with one coat of MIL-DTL-24441/7 Formula 156 (red) or SSPC Paint 22 topcoat (red) applied to a dry film thickness of 0.076 mm .

2.14.2 Concentrate Ratio Controller

Ratio controller shall be a modified venturi device with AFFF concentrate feed line from diaphragm tank(s), and integral concentrate metering orifice. Size for specified flow rate(s).

2.15 BALANCED PRESSURE PROPORTIONING SYSTEM

Foam solution shall be produced by introducing AFFF concentrate into the water stream by the balanced pressure proportioning method using a pump and proportioner.

2.15.1 Skid-Mounted Balanced Pressure Proportioning System

Self-contained, skid-mounted system, fully assembled at the factory and delivered complete and ready for use. Field connections shall be limited to water, electrical, and AFFF concentrate inputs, foam solution output, and foam concentrate return line to storage tank. Size system for required flow rate(s). The concentrate pump and all piping, valves, and fittings in contact with foam concentrate shall be of



materials resistant to the corrosive effects of the AFFF concentrate. Concentrate pump shall be electric motor driven, drip proof, 240/480 volts, 60 Hz AC. Activation and operation of system shall be fully automatic, with manual over-ride and manual shut-down. Provide permanent engraved rigid plastic or corrosion resistant metal instruction plate for emergency manual operation, along with a similarly constructed label for each control device.

2.15.2 In-Line Balanced Pressure Proportioning System

Size system for required flow rates. AFFF concentrate pump shall be positive displacement, electric motor driven, drip proof, 240/480 volts, 60 Hz AC. System operation shall be fully automatic, with manual over-ride and manual shut-down. Provide a pressure regulating device in the AFFF concentrate pump return line to maintain constant pressure on the concentrate piping system at all AFFF solution flow rates. Provide an in-line balanced pressure proportioning device at each system riser to automatically balance the AFFF concentrate pressure with the water pressure at the riser to provide correct proportioning over the range of flow rates calculated for that riser. The pump and all piping, valves, and fittings in contact with the foam concentrate shall be of materials resistant to the corrosive effects of the AFFF concentrate. Provide permanent engraved rigid plastic or corrosion-resistant metal instruction plate for emergency manual operation, along with a similarly constructed label for each control device.

2.15.3 AFFF Concentrate Storage Tanks

Tank shall be designed for storage of AFFF concentrate at atmospheric pressure, and shall be [horizontal] [or] [vertical] cylindrical, fiberglass or polyethylene construction. Tank shall have the following: Drain valve located at the lowest point in the tank, connections for concentrate supply and return lines to the proportioners, top-mounted fill connections and inspection hatch, and a pressure/vacuum relief vent. All openings and tank connections shall be installed at the factory, no holes shall be made in the tank shell in the field. Tank shall include all necessary supports for free-standing installation. Provide a gage or unbreakable sight glass to permit visual determination of level of tank contents, unless liquid level is clearly visible through shell of tank. Size tank to provide sufficient AFFF concentrate for the time specified when the system is discharging foam solution at total maximum system flow. Also provide connected reserve tank(s) of equal capacity. Permanently label each tank with its capacity, type and percentage of concentrate, which system it serves, and whether it is a main or reserve tank.

2.16 OSCILLATING MONITOR NOZZLES

Fixed, water motor operated, with override to allow manual aiming. Oscillation arc shall be adjustable from at least 0 to 2.88 radian 165 degrees. Oscillation speed shall be adjustable from 0 to 0.52 radian 30 degrees per second. Nozzle shall be adjustable while in operation from 0.52 radian 30 degrees below to 1.40 radian 80 degrees above horizontal, with lock or latching mechanism. Nozzle shall be air aspirating type, adjustable while in operation from straight stream to fan-spray. Nozzle shall be capable of retaining the adjusted setting once the desired pattern has been set. [Nozzle shall produce a straight stream of 46 meters at 1920 L/m and [690 kPa (gage)] Nozzles shall provide a minimum application rate of 4.2L/m per sq meter over the entire floor area underneath the aircraft wings and fuselage. Provide normally open OS&Y gate valve in supply line at each monitor location.



2.17 HAND HOSE LINES

Provide each hose station with flow-through reel and 30 meter of 40 mm hard rubber hose and nozzles. Nozzle shall have pistol-grip ball shutoff valve. Nozzle shall be air aspirating type. Provide normally closed quarter-turn ball valve in supply line at each hose station. Nozzle flow rate shall be 228 L/m minimum.

2.18 WALL FOAM HYDRANTS

Provide dual outlet connections with integral gate valves and locate about one meter above grade. Provide each outlet with 65 mm male National Standard hose threads with cap and chain. Hydrant shall be controlled by OS&Y gate valve located inside foam room. Provide wall escutcheon plate with "FOAM HYDRANT" in raised letters cast in plate. [Hydrant shall permit testing of each pre-action system riser at full design flow without charging the system supplied by the riser.]

2.19 ABOVEGROUND PIPING SYSTEMS

2.19.1 Pipe, Fittings, and Mechanical Couplings

To be as per NFPA 13, except steel piping shall be Schedule 40 for sizes smaller than 200 mm , and Schedule 30 or 40 for sizes 200 mm and larger. Pipe nipples 150 mm long and shorter shall be Schedule 80 steel pipe. Water motor alarm piping shall be zinc-coated steel pipe and fittings. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall only be permitted in pipe sizes 40 mm and larger. Rubber gaskets shall be UL listed for use in dry-pipe sprinkler systems. Use of restriction orifices, reducing flanges, and plain-end fittings with mechanical couplings (which utilize steel gripping devices to bite into the pipe when pressure is applied) are not permitted. Pipe and fittings in contact with AFFF concentrate shall be material resistant to the corrosive effects of AFFF concentrate as approved by the manufacturer of the proportioning system. Fittings on concentrate lines shall be flanged or welded only. Screwed or mechanical fittings will not be permitted.

2.19.2 Jointing Material

To be as per FS A-A-58092, Polytetrafluoroethylene (PTFE) tape. Pipe joint compound (pipe dope) is not acceptable.

2.19.3 Duplex Basket Strainers

Include for deluge systems with high volume flow, and for untreated water supply.

FS WW-S-2739, Style Y (Y pattern). Provide duplex basket strainers with removable screens having standard perforations, 3 mm in diameter in the riser beneath the deluge valves.

2.19.4 Pipe Hangers and Supports

To be as per NFPA 13 .





2.19.5 Valves

Provide valves as required by NFPA 13 and of types approved for fire service. Gate valves shall open by counterclockwise rotation. Check valves shall be flanged clear opening swing check type with flanged inspection and access cover plate for sizes 100 mm and larger. Provide an OS&Y valve beneath each [deluge] or [pre-action] valve in each riser, when more than one valve is supplied from the same water supply pipe. Butterfly valves are not acceptable.

2.19.6 Identification Signs

Attach properly lettered approved metal signs conforming to NFPA 13 to each valve and alarm device. Permanently affix design data nameplates to the riser of each system.

2.19.7 Inspector's Test Connection

Include for pre-action systems.

Provide test connections about 2 meters above the floor for each sprinkler system and locate at the hydraulically most remote part of each system. Provide test connection piping to a location where the discharge will be readily visible and where water may be discharged without damage.

2.19.8 Main Drains

Provide drain piping to discharge at safe points outside each building or to sight cones attached to drains of adequate size to readily receive the full flow from each drain under maximum pressure. Provide auxiliary drains as required by NFPA 13.

2.19.9 Pipe Sleeves

Provide where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 6 mm space between exterior of piping and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement.

2.19.9.1 Sleeves in Masonry and Concrete Walls, Floors, Roofs

ASTM A 53/A 53M, schedule 40 or standard weight, zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 80 mm above the finished floor.

2.19.9.2 Sleeves in Partitions

Provide zinc-coated steel sheet having a nominal weight of not less than 4.40 kg per sq meter.



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2.19.10 Escutcheon Plates

Provide one piece or split hinge type plates for piping passing through floors, walls and ceilings, in both exposed and concealed areas. Provide chromium plated metal plates where pipe passes through finished ceilings. Provide other plates of steel or cast iron with aluminum paint finish. Securely anchor plates in place.

2.19.11 Fire Department breaching Connections

Two way type with 65 mm National Standard female hose threads with plug, chain, and identifying fire department connection escutcheon plate.

2.19.12 Backflow Preventers

Reduced pressure principle type. Proof shall be furnished that each make, model/design, and size of backflow preventer being furnished for the project is approved by and has a current "Certificate of Approval" from the FCCCHR List. Listing of the particular make, model/design, and size in the current FCCCHR List will be acceptable as the required proof.

2.20 BURIED PIPING SYSTEMS

2.20.1 Pipe and Fittings

to be as per NFPA 24, and Section 33 11 00 WATER DISTRIBUTION

2.20.2 Valves

Provide as required by NFPA 24 and 33 11 00 WATER DISTRIBUTION, for fire service. Gate valves shall conform to AWWA C500 or UL 262 with cast iron body and bronze trim, and shall open by counterclockwise rotation.

2.20.3 Post Indicator Valves

To be as Section 33 11 00 WATER DISTRIBUTION .

2.20.4 Valve Boxes

To be as Section 33 11 00 WATER DISTRIBUTION

2.20.5 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of



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buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 76 mm 3 minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be CAUTION BURIED WATER PIPING BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 305 mm below the top surface of earth or the top surface of the subgrade under pavements.





PART 3 EXECUTION

3.1 EXCAVATION, BACKFILLING, AND COMPACTING

To be as per specified in Section 31 00 00 EARTHWORK.

3.2 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around the mains; bolt valve conforming to AWWA C500 or UL 262 to the branch. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, all without interruption of service. Notify CMW Engineer in writing at least 15 calendar days prior to the date the connections are required; approval shall be received before any service is interrupted. Furnish all material required to make connections into the existing water supply systems, and perform all excavating, backfilling, and other incidental labor as required. Furnish the labor and the tapping or drilling machine for making the actual connections to the existing systems.

3.3 AFFF SYSTEM INSTALLATION

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the NFPA standards and UAE SAFETY AND FIRE PROTECTION CODE OF PRACTICE referenced herein. Install piping straight and true to bear evenly on hangers and supports. Conceal piping to the maximum extent possible. Piping shall be inspected, tested and approved before being concealed. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; do not use bushings. Cut pipe accurately and work into place without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Clean with solvent to remove all varnish and cutting oil prior to assembly. Make screw joints with PTFE tape applied to male thread only.

3.4 DISINFECTION

Disinfect new water piping from the system control valve to the point of connection at the water main and existing water piping affected by the Contractor's operation in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 mg/kg parts per million (ppm) of free available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 mg/kg ppm.

3.5 FIELD PAINTING

Clean, prime, and paint new foam systems including valves, piping, conduit, hangers, miscellaneous metal work, and accessories. Apply coatings to clean dry surfaces using clean brushes. Clean the surfaces in accordance with SSPC SP 11. Immediately after cleaning, prime the metal surfaces with one coat of SSPC Paint 25 or SSPC Paint 25 primer applied to a minimum dry film thickness of 0.04 mm. Exercise care to avoid the painting of sprinkler heads and operating devices. Upon completion of painting, remove materials which were used to protect sprinkler heads and operating devices while painting is in process. Remove sprinkler heads and operating devices which have been inadvertently painted and provide new clean sprinkler heads and operating devices of the proper type. Finish primed surfaces as follows:



3.5.1 Foam Systems in Unfinished Areas

Unfinished areas are defined as attic spaces, spaces above suspended ceilings, crawl spaces, foam rooms, pump rooms, pipe chases, and other spaces where ceilings are not painted or not constructed of a prefinished material. Paint primed surfaces with two coats of FS A-A-2962 red enamel applied to a minimum dry film thickness of 0.04 mm.

3.5.2 Foam Systems in All Other Areas

Paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with two coats of FS A-A-2962 red enamel applied to a minimum dry film thickness of 0.04 mm. Provide piping with 50 mm wide red bands spaced at maximum 6 meters intervals throughout the piping systems. Bands shall be red enamel or self adhering red plastic tape.

3.5.3 Piping Labels

Provide permanent labels in foam rooms, spaced at 6 meters maximum intervals along pipe, indicating "WATER", "FOAM CONCENTRATE", and "FOAM SOLUTION" on corresponding piping.

3.5.4 Field Touch-Up

Clean damaged areas of shop coated tanks in accordance with SSPC SP 11 and coat cleaned areas with the same materials used for the shop applied coating system.

3.6 ELECTRICAL WORK

Electrical work is specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control and fire alarm wiring. Fire alarm system is specified in Section 28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM

3.6.1 Wiring

Provide control wiring, and connections to fire alarm systems, under this section in accordance with NFPA 70 and NFPA 72. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage. Do not run low voltage DC circuits in the same conduit with AC circuits. [Run wiring to UV-IR detectors alone in separate conduit if required by the detector manufacturer.]

3.7 FLUSHING

Flush the piping system with potable water in accordance with NFPA 13. Continue flushing operation until water is clear, but for not less than 10 minutes.

3.8 FIELD QUALITY CONTROL

Prior to initial operation, inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals.





Perform tests in the presence of CMW Engineer to determine conformance with the specified requirements.

3.8.1 Preliminary Tests

Each piping system shall be hydrostatically tested at 1379 kPa (gage) in accordance with NFPA 13 and shall show no leakage or reduction in gage pressure after 2 hours. The Contractor shall conduct complete preliminary tests, which shall encompass all aspects of system operation. Individually test all detectors, manual actuation stations, alarms, control panels, and all other components and accessories to demonstrate proper functioning. Test water flow alarms by flowing water through the inspector's test connection. When tests have been completed and all necessary corrections made, submit to CMW Engineer a signed and dated certificate, similar to that specified in NFPA 13, attesting to the satisfactory completion of all testing and stating that the system is in operating condition. Also include a written request for a formal inspection and test.

3.8.2 Formal Inspection and Tests (Acceptance Tests)

CMW Engineer (s) will witness formal tests and approve all systems before they are accepted. The system shall be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and written certification to this effect is received by the Fire Protection Engineer. Submit the request for formal inspection at least 15 working days prior to the date the inspection is to take place. The control panel(s) and detection system(s) shall be in continuous service for a "break-in" period of at least 15 consecutive days prior to the formal inspection. Experienced technicians regularly employed by the Contractor in the installation of both the mechanical and electrical portions of such systems shall be present during the inspection and shall conduct the testing. All AFFF concentrate, instruments, [including UV-IR detector test lamp and function test kit,] personnel, appliances and equipment for testing shall be furnished by the Contractor. All necessary tests encompassing all aspects of system operation shall be made including the following, and any deficiency found shall be corrected and the system retested at no cost to the Government.

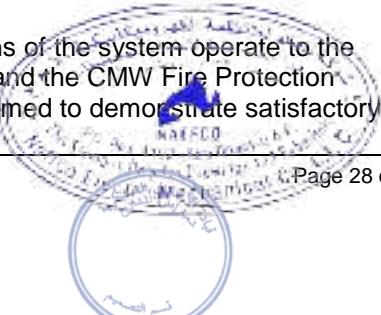
3.8.2.1 Systems and Device Testing

The entire initiating, alarm, actuation systems shall be operated. As a minimum, operation and supervision of the following functions and devices shall be demonstrated:

- a. All operational and supervisory functions of the control and annunciator panels.
- b. Each manual actuation station and associated circuit(s).
- c. All detectors and associated circuits.
- d. All alarms and associated circuits.
- e. All actuator circuits and system control valve(s) (without foam discharge).
- f. Activation of the building fire evacuation alarm system.
- g. Activation of the Base fire alarm system (receipt of fire alarm at alarm office).
- h. All of the above tests shall then be repeated with the system on battery power only.

3.8.2.2 AFFF Discharge and Concentration Testing

When all of the initiating, alarm, actuation, and supervisory functions of the system operate to the satisfaction of the system manufacturer's technical representative and the CMW Fire Protection Engineer, a complete discharge test of each system shall be performed to demonstrate satisfactory





performance, proper AFFF concentration, mechanical operation and operation of valves, release devices, alarms, and interlocks which control the protected areas. These tests shall be conducted by experienced personnel according to the equipment and AFFF manufacturers' recommendations.

- a. Test each deluge system by full flow of foam solution from the individual systems or combination of systems to achieve maximum design flow rate for at least 60 seconds.
- b. Test each pre-action system at their design flow rate for at least 60 seconds with temporary hose lines and nozzles connected to a test header. Furnish hose and nozzles required for tests.
- c. Test all hose lines and monitor nozzles by full flow of foam solution for at least 60 seconds.

The manufacturer's representative shall test samples of foam solution taken from each system to ensure proper AFFF concentration. Provide protection for all electrical fixtures and equipment exposed to possible damage during tests and protect doors and other openings leading from the protected area(s), to prevent migration of foam solution into other areas or spaces.

3.8.2.3 Flushing and Rinsing

After completion of tests flush all piping carrying AFFF concentrate and solution with fresh water. Piping normally containing AFFF concentrate when the system is in standby mode need not be flushed. Rinse with fresh water all equipment and building surfaces exposed to AFFF discharge.

3.8.3 Environmental Protection

Provide temporary measures to prevent AFFF from entering storm drains, sanitary sewers, drainage ditches, streams and water courses. Collect all discharged AFFF and rinse and flushing water and dispose of it in an EPA - approved waste-water treatment facility which provides secondary (biological) treatment. At least 15 days prior to the date flow testing is to take place, submit written plan for AFFF containment and disposal methods(s) to CMW Engineer for approval.

3.8.4 Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, CMW Engineer shall be notified when the additional work has been completed, to arrange a new inspection and test of the system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

3.8.5 AFFF Concentrate Storage Tanks Fill-Up

Fill storage tanks including reserve tanks and piping normally containing concentrate when the system is in standby mode with Contractor furnished AFFF concentrate after acceptance of the system.

3.8.6 Manufacturer's Representative





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Provide the services of representatives or technicians from the manufacturers of the foam system, and control panel , and UV-IR detectors, experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Government personnel.

3.9 OPERATING INSTRUCTIONS

Provide operating instructions at control equipment and at each remote control station. Instructions shall clearly indicate all necessary steps for the operation of the system. Submit the proposed legend for operating instructions for approval prior to installation. Instructions shall be in engraved white letters on red rigid plastic or red enameled steel backgrounds and shall be of adequate size to permit them to be easily read.

3.10 TRAINING REQUIREMENTS

Prior to final acceptance, the Contractor shall provide operation and maintenance training to the Base Fire Department and final user personnel, training session shall include emergency procedures, and unique maintenance and safety requirements. The training conducted shall use operation and maintenance manuals specified in paragraph entitled "Operations and Maintenance Manuals". Dates and times of the training period shall be coordinated through CMW Engineer and the final user

3.11 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurement, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements shown are as follows:

Products	Inch-Pound	Metric
a. Air Compressor Tank Capacity	= 10 gallons	= 38 liters
b. Concentrate Fill Pump Flow Rate	= 7 gpm	= 27 L/m
c. Diaphragm Pressure Proportioning Tanks Working Pressure	= 175 psig	= 1206 kPa (gage)

-- End of Section --



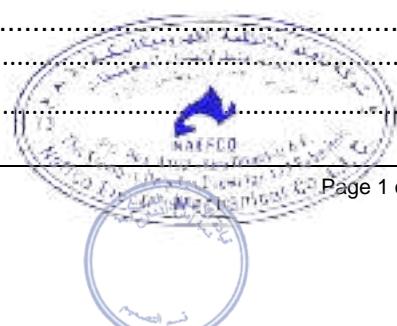


SECTION 21 30 00

FIRE PUMPS

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - a. AWWA 10084 (2005) Standard Methods for the Examination of Water and Wastewater
 - b. AWWA B300 (2004) Hypochlorites
 - c. AWWA B301 (2004) Liquid Chlorine
 - d. AWWA C104/A21.4 (2008) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - e. AWWA C110/A21.10 (2008) Ductile-Iron and Gray-Iron Fittings for Water
 - f. AWWA C111/A21.11 (2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - g. AWWA C151/A21.51 (2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
 - h. AWWA C500 (2009) Metal-Seated Gate Valves for Water Supply Service
 - i. AWWA C606 (2006) Grooved and Shouldered Joints
2. ASME INTERNATIONAL (ASME)
 - a. ASME B16.11 (2009) Forged Fittings, Socket-Welding and Threaded
 - b. ASME B16.18 (2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
 - c. ASME B16.21 (2005) Non-metallic Flat Gaskets for Pipe Flanges
 - d. ASME B16.22 (2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - e. ASME B16.26 (2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
 - f. ASME B16.3 (2006) Malleable Iron Threaded Fittings, Classes 150 and 300
 - g. ASME B16.39 (2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300



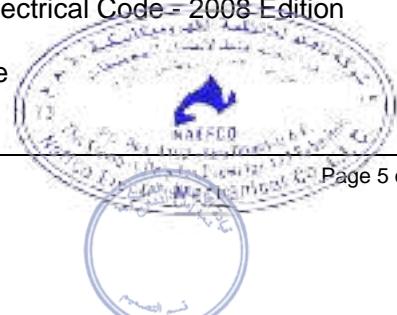


- h. ASME B16.5 (2009) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
- i. ASME B16.9 (2007) Standard for Factory-Made Wrought Steel Butt welding Fittings
- j. ASME B31.1 (2007; Addenda 2008; Addenda 2009) Power Piping
- 3. ASTM INTERNATIONAL (ASTM)
 - a. ASTM A 183 (2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
 - b. ASTM A 193/A 193M (2009) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
 - c. ASTM A 194/A 194M (2009) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
 - d. ASTM A 449 (2007b) Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
 - e. ASTM A 47/A 47M (1999; R 2009) Standard Specification for Steel Sheet, Aluminium-Coated, by the Hot-Dip Process
 - f. ASTM A 53/A 53M (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - h. ASTM A 536 (1984; R 2009) Standard Specification for Ductile Iron Castings
 - i. ASTM A 563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts
 - j. ASTM A 563M (2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
 - k. ASTM A 795/A 795M (2008) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
 - l. ASTM B 135 (2008a) Standard Specification for Seamless Brass Tube
 - m. ASTM B 135M (2008a) Standard Specification for Seamless Brass Tube (Metric)
 - n. ASTM B 42 (2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes
 - o. ASTM B 62 (2009) Standard Specification for Composition Bronze or Ounce Metal Castings Copper Tube
 - p. ASTM B 75M (1999; R 2005) Standard Specification for Seamless Copper Tube (Metric)





- k. ASTM B 88 (2009) Standard Specification for Seamless Copper Water Tube
 - l. ASTM B 88M (2005) Standard Specification for Seamless Copper Water Tube (Metric)
 - m. ASTM C 533 (2009) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
 - n. ASTM D 2000 (2008) Standard Classification System for Rubber Products in Automotive Applications
 - o. ASTM D 3308 (2006) PTFE Resin Skived Tape
 - p. ASTM F 436 (2009) Hardened Steel Washers
 - q. ASTM F 436M (2009) Hardened Steel Washers (Metric)
4. FM GLOBAL (FM)
- a. FM P7825a (2005) Approval Guide Fire Protection
 - b. FM P7825b (2005) Approval Guide Electrical Equipment
5. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
- a. MSS SP-58 (2009) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
 - b. MSS SP-69 (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
 - c. MSS SP-80 (2008) Bronze Gate, Globe, Angle and Check Valves
6. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
- a. NEMA MG 1 (2007; Errata 2008) Standard for Motors and Generators
7. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
- a. NFPA 1963 (2009) Standard for Fire Hose Connections
 - b. NFPA 20 (2010) Installation of Stationary Pumps for Fire Protection
 - c. NFPA 24 (2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
 - d. NFPA 37 (2010) Installation and Use of Stationary Combustion Engines and Gas Turbines
 - e. NFPA 70 (2008; AMD 1 2008) National Electrical Code - 2008 Edition
 - f. NFPA 72 (2010) National Fire Alarm Code

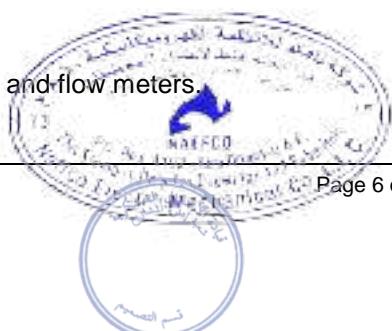




8. NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)
 - a. NICET 1014-7 (2003) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout
9. UNDERWRITERS LABORATORIES (UL)
 - a. UL 1247 (200; Rev thru Sep 2008) Diesel Engines for Driving Centrifugal Fire Pumps
 - b. UL 142 (2006; Rev thru Dec 2007) Steel Aboveground Tanks for Flammable and
 - c. Combustible Liquids
 - d. UL 262 (2004) Standard for Gate Valves for Fire-Protection Service
 - e. UL 448 (2007) Pumps for Fire-Protection Service
 - f. UL 80 (2007; Rev thru Aug 2009) Steel Tanks for Oil-Burner Fuel
 - g. UL Fire Prot Dir (2009) Fire Protection Equipment Directory
10. UAE Fire and Life Safety Code of Practice

1.2 SYSTEM DESCRIPTION

- A. .install fire pumps in conformance with NFPA 20, NFPA 70, and NFPA 72, including all recommendations and advisory portions, which shall be considered mandatory; this includes advisory provisions listed in the appendices of such standards, Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM P7825a approved.
- B. Tank supports, piping offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete installation and to eliminate interference with other construction.
- C. Show detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Show piping schematic of pumps, devices, valves, pipe, and fittings.
Provide an isometric drawing of the fire pump and all associated piping. Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Show engine fuel and cooling system. Include:
 - (1) Pumps, drivers, and controllers
 - (2) Hose valve manifold test header
 - (3) Circuit diagrams for pumps
 - (4) Wiring diagrams of each controller
- D. Post operating instructions for pumps, drivers, controllers, and flow meters.





Section: 21 30 00 FIRE PUMPS

- E. Fully enclose or properly guard coupling, rotating parts, gears, projecting equipment, etc. so as to prevent possible injury to persons that come in close proximity of the equipment. Conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams..

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

A. SD-02 Shop Drawings

1. Installation Requirements

Three copies of the Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1:20 . Drawings shall indicate equipment, piping, and associated pump equipment to scale. All clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment shall be indicated. Drawings shall include a legend identifying all symbols, nomenclatures, and abbreviations. Drawings shall indicate a complete piping and equipment layout including elevations and/or section views of the following:

- a. Fire pumps, controllers, piping, valves, and associated equipment.
- b. Sensing line for each pump including the pressure maintenance pump.
- c. Engine fuel system for diesel driven pumps.
- d. Engine cooling system for diesel driven pumps.
- e. Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.
- f. Restraint of underground water main at entry-and exit-points to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.
- g. A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.
- h. A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

2. As-Built Drawings

As-built drawings, as specified.

3. Piping Layout and Sensing piping Arrangement

4. Pump Room

B. SD-03 Product Data

1. Fire Pump Installation Related Submittals

A list of the Fire Pump Installation Related Submittals .

2. Installation Requirements





Manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

- a. Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.
- b. Pressure maintenance pump and controller.
- c. Piping components.
- d. Valves, including gate, check, globe and relief valves.
- e. Gauges.
- f. Hose valve manifold test header and hose valves.
- g. Flow meter.
- h. Restrictive orifice union.
- i. Associated devices and equipment.

3. Spare Parts

Spare parts data for each different item of material and equipment specified .

4. Preliminary Tests

Proposed procedures for Preliminary Tests, at least 14 days prior to the proposed start of the tests.
Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

5 . Field Tests

Proposed diagrams, at least 2 weeks prior to start of related testing .

6 . Fire Protection Specialist

The name and documentation of certification of the proposed Fire Protection Specialists, prior to the submittal of the fire pump installation drawings .

7 . Manufacturer's Representative

The name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the Fire Protection Specialist Qualifications .

C. SD-06 Test Reports

1. Preliminary Tests

Three copies of the completed Preliminary Tests Reports, no later than 5 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist and by the Manufacturer's Representative.

2. Final Test





Section: 21 30 00 FIRE PUMPS

Three copies of the completed final test Reports , no later than 5 days after the completion of the tests. All items in the reports shall be signed by the Fire Protection Specialist and the Manufacturer's Representative. Test reports in booklet form showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches. The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report.

D. SD-07 Certificates

1. Fire Protection Specialist

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the fire pump installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

2. Qualifications of Welders

3. Qualifications of Installer

Certificates of qualifications, as specified .

4. Preliminary Test Certification

Request for formal inspection and tests, as specified

5. Certificate of origin

6. Certificate of unconditioned 5 years warranty

E. SD-10 Operation and Maintenance Data

1. Fire Pumps

4 manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Data Package shall be submitted for fire pumps and drivers in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Fire Protection Specialist





Section: 21 30 00 FIRE PUMPS

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be specialized subcontractor who is certified by UAE Civil Defence in the Automatic Sprinkler System design, studies, erection, installation, operating, maintaining, testing and commissioning. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least five systems that have performed in the manner intended for a period of not less than 6 months.[Submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.]

1.4.2 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; certifications shall not be more than one year old.

1.4.3 Qualifications of Installer

Prior to installation, submit data for approval showing that the Contractor has successfully installed fire pumps and associated equipment of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least three installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

1.4.4 Preliminary Test Certification

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

1.4.5 Manufacturer's Representative

Work specified in this section shall be performed under the supervision of and certified by a representative of the fire pump manufacturer. The Manufacturer's Representative shall be regularly engaged in the installation of the type and complexity of fire pump(s) specified in the Contract documents, and shall have served in a similar capacity for at least five systems that have performed in the manner intended for a period of not less than 6 months.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall be either capped or plugged until installed.





PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- a. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 5 years prior to bid opening.
- b. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, ; capacity or size; system in which installed and system which it controls and catalog number. Pumps and motors shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

2.2 FIRE PUMP

Fire pump set shall be one electric motor driven and one diesel engine driven. Each pump capacity and pressure of shall be as indicated on plans. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal [horizontal split case] or [water lubricated, vertical shaft turbine] end suction fire pump as indicated on plans.

Horizontal pump shall be equipped with automatic air release devices. The maximum rated pump speed shall be 2100 rpm when driving the pump at rated capacity. Pump shall be automatic start and manual stop [automatic start and automatic stop]. Pump shall conform to the requirements of UL 448.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

2.3.1 General Requirements

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

2.3.2 Alarms

Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72. Provide remote alarm devices located where shown. Alarm signal shall be activated upon the following conditions. Exterior alarm devices shall be weatherproof type. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.





CMW GENERAL SPECIFICATION DIVISION 21

Section: 21 30 00 FIRE PUMPS

2.4 PIPING COMPONENTS

2.4.1 Pipe Sizes 65 mm and Larger

2.4.1.1 Pipe

Piping shall be [ASTM A 53/A 53M][ASTM A 795/A 795M], Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 200 mm greater in diameter), Type E or Type S, Grade A; black steel pipe. Steel pipe shall be joined by means of flanges welded to the pipe or mechanical grooved joints only. Piping shall not be jointed by welding or weld fittings. Suction piping shall be galvanized on the inside in accordance with NFPA 20.

2.4.1.2 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 1200 kPa service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.4.1.3 Flanges

Flanges shall be ASME B16.5, Class 150 flanges. Flanges shall be provided at valves, connections to equipment, and where indicated.

2.4.1.4 Gaskets

Gaskets shall be AWWA C111/A21.11, cloth inserted red rubber gaskets .

2.4.1.5 Bolts

Bolts shall be [ASTM A 449, Type [1][2]][ASTM A 193/A 193M, Grade B7]. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.4.1.6 Nuts

Nuts shall be [ASTM A 194/A 194M, Grade 7][ASTM A 193/A 193M, Grade 5][ASTM A 563M ASTM A 563, Grade [C3][DH3]].

2.4.1.7 Washers

Washers shall meet the requirements of ASTM F 436M ASTM F 436. Flat circular washers shall be provided under all bolt heads and nuts.

2.4.2 Piping Sizes 50 mm and Smaller

2.4.2.1 Steel Pipe

Steel piping shall be [ASTM A 795/A 795M, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A][ASTM A 53/A 53M, Weight Class XS (Extra Strong)], zinc-coated steel pipe with threaded end connections. Fittings shall be [ASME B16.3][ASME B16.39], Class 150, zinc-coated threaded fittings. Unions shall be ASME B16.39, Class 150, zinc-coated unions.



2.4.2.2 Copper Tubing

Copper tubing shall be ASTM B 88M ASTM B 88, Type L or K, soft annealed. Fittings shall be ASME B16.26, flared joint fittings. Pipe nipples shall be ASTM B 42 copper pipe with threaded end connections.

2.4.3 Pipe Hangers and Supports

Pipe hangers and support shall be [MSS SP-58 and MSS SP-69][UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b] and shall be the adjustable type. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.

2.4.4 Valves

Valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire protection service. Valves shall have flange or threaded end connections.

2.4.4.1 Gate Valves and Control Valves

Gate valves and control valves shall be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are not permitted.

2.4.4.2 Tamper Switch

The suction control valves, the discharge control valves, valves to test header and flow meter, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

2.4.4.3 Check Valve

Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

2.4.4.4 Relief Valve

Relief valve shall be [pilot operated][or][spring operated] type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

2.4.4.5 Circulating Relief Valve

An adjustable circulating relief valve shall be provided for each fire pump in accordance with NFPA 20.



2.4.4.6 Suction Pressure Regulating Valve

Suction pressure regulating valve shall be FM approved FM P7825a and FM P7825b. Suction pressure shall be monitored through a pressure line to the controlling mechanism of the regulating valve. Valve shall be arranged in accordance with the manufacturer's recommendations.

2.4.5 Hose Valve Manifold Test Header

Construct header of steel pipe. Provide ASME B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide approved bronze hose gate valve with 65 mm National Standard male hose threads with cap and chain; locate one meter above grade in the horizontal position for each test header outlet. Welding shall be metallic arc process in accordance with ASME B31.1.

2.4.6 Pipe Sleeves

A pipe sleeve shall be provided at each location where piping passes entirely through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide 25 mm minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07 84 00 FIRESTOPPING.

2.4.7 Escutcheon Plates

Provide one-piece or split-hinge metal plates for piping entering floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Plates shall be secured in place.

2.5 DISINFECTING MATERIALS

2.5.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.5.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.6 ELECTRIC MOTOR DRIVER

Motors, controllers, contactors, and disconnects shall be provided with their respective pieces of equipment, as specified herein and shall have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Controllers and contactors shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.



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Motor shall conform to NEMA MG 1 Design B type. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1. Motor wattage, horsepower shall be of sufficient size so that the nameplate wattage horsepower rating will not be exceeded throughout the entire published pump characteristic curve. The motor and fire pump controller shall be fully compatible.

2.7 DIESEL ENGINE DRIVER

Diesel engine driver shall conform to the requirements of UL 1247 and shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire pump service. Driver shall be of the make recommended by the pump manufacturer. The engine shall be closed circuit, liquid-cooled [with raw water heat exchanger] or [with radiator and engine-driven fan]as indicated. Diesel engine shall be electric start type taking current from 2 battery units. Engine shall be equipped with a fuel in-line filter-water separator. Engine conditions shall be monitored with engine instrumentation panel that has a tachometer, hour meter, fuel pressure gauge, lubricating oil pressure gauge, water temperature gauge, and ammeter gauge. Engine shall be connected to horizontal-shaft pump by flexible couplings. For connections to vertical-shaft fire pumps, right-angle gear drives and universal joints shall be used. An engine jacket water heater shall be provided to maintain a temperature of 49 degrees C in accordance with NFPA 20.

2.7.1 Engine Capacity

Engine shall have adequate wattage horsepower to drive the pump at all conditions of speed and load over the full range of the pump performance curve. The wattage horsepower rating of the engine driver shall be as recommended by the pump manufacturer and shall be derated for temperature and elevation in accordance with NFPA 20.

2.7.2 Exhaust System External to Engine

Exhaust system shall comply with the requirements of NFPA 20 and NFPA 37. An exhaust muffler shall be provided for each diesel engine driver to reduce noise levels less than [85] dBA. A flexible connector with flange connections shall be provided at the engine. Flexible sections shall be stainless steel suitable for diesel-engines exhaust gas at 538 degrees C

2.7.2.1 Steel Pipe and Fittings

ASTM A 53/A 53M, [Schedule 40 black steel, welding end connections. ASME B16.9 or ASME B16.11 welding fittings shall be of the same material and weight as the piping.

2.7.2.2 Flanges

ASME B16.5, Class [300]or [150]. Flanges shall be provided at connections to diesel engines, exhaust mufflers, and flexible connections. Gaskets shall be ASME B16.21, composition ring, 1.5875 mm. ASTM A 193/A 193M,Grade [B8] or [B7] bolts and ASTM A 194/A 194M, Grade [8][7] nuts shall be provided.

2.7.2.3 Piping Insulation

Products containing asbestos will not be permitted.





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Exhaust piping system including the muffler shall be insulated with ASTM C 533 calcium silicate insulation, minimum of 75 mm. Insulation shall be secured with not less than 9.525 mm width fibrous glass reinforced waterproof tape or Type 304 stainless steel bands spaced not more than 200 mm on center. An aluminum jacket encasing the insulation shall be provided. The aluminum jacket shall have a minimum thickness of 0.406 mm, a factory-applied polyethylene and Kraft paper moisture barrier on the inside surface. The jacket shall be secured with not less than 13 mm wide stainless steel bands, spaced not less than 200 mm on centers. Longitudinal and circumferential seams of the jacket shall be lapped not less than 75 mm.

Jackets on horizontal line shall be installed so that the longitudinal seams are on the bottom side of the pipe. The seams of the jacket for the vertical lines shall be placed on the off-weather side of the pipe. On vertical lines, the circumferential seams of the jacket shall overlap so the lower edge of each jacket overlaps the upper edge of the jacket below.

2.8 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Automatic stopping shall be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed.

Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 4 watertight and dust tight enclosure arranged so that controller current carrying parts will not be less than 300 mm above the floor.

Controller shall be provided with voltage surge arresters installed in accordance with NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light.

2.8.1 Controller for Electric Motor Driven Fire Pump

Controller shall be [electronic soft start], [across the line], [auto-transformer], [wye-delta, open circuit transition], [wye-delta, closed circuit transition] starting type as indicated. Controller shall be designed for voltage and horsepower as indicated. Controller shall have a short circuit rating as indicated.

Controller shall monitor pump running, loss of a phase or line power, phase reversal.

Alarms shall be individually displayed in front of panel by lighting of visual lamps. Each lamp shall be labeled with rigid etched plastic labels. Controller shall be equipped with terminals for remote monitoring of pump running, pump power supply trouble (loss of power or phase and phase reversal)

Limited service fire pump controllers are not permitted, except for fire pumps driven by electric motors rated less than 11 kW 15 hp. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour spring wound back-up. The pressure recorder shall provide a readout of the system pressure from 0 to 207 Pa, time, and date. Controller shall require the pumps to run for ten minutes for pumps with driver motors under 149 kW and for 15 minutes for pumps with motors 149 kW and greater, prior to automatic shutdown. The controller shall be equipped with an externally operable isolating switch which manually operates the motor circuit. Means shall be provided in the controller for measuring current for all motor circuit conductors.

2.8.2 Controller for Diesel Engine Driven Fire Pump

Controller shall require the pump to run for 30 minutes prior to automatic shutdown. Controller shall be equipped with two battery chargers; two ammeters; two voltmeters, one for each set of batteries. Controller shall automatically alternate the battery sets for starting the pumps.

Controller shall be equipped with the following supervisory alarm functions:



a. Engine Trouble (individually monitored)

- (1) Engine overspeed
- (2) Low Oil Pressure
- (3) High Water Temperature
- (4) Engine Failure to Start
- (5) Battery
- (6) Battery Charger/AC Power Failure

b. Main Switch Mis-set

c. Pump Running

Alarms shall be individually displayed in front of panel by lighting of visual lamps, except that individual lamps are not required for pump running and main switch mis-set. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour back-up mounted inside the controller. The pressure recorder shall provide a readout of the system pressure from 0 to 207 Pa, time, and date. The controller shall be equipped with an audible alarm which will activate upon any engine trouble or pump room trouble alarm condition and alarm silence switch. Controller shall be equipped with terminals for field connection of a remote alarm for main switch mis-set, pump running, engine trouble and pump room trouble. When engine emergency overspeed device operates, the controller shall cause the engine to shut down without time delay and lock out until manually reset.

2.9 BATTERIES

Batteries for diesel engine driver shall be sealed lead calcium batteries.

Batteries shall be mounted in a steel rack with non-corrosive, non-conductive base, not less than 300 mm above the floor.

2.10 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be 13 mm H58 brass tubing complying with ASTM B 135M ASTM B 135. The sensing line shall be equipped with two restrictive orifice unions each.

Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 2.4 mm. Restricted orifice unions shall be mounted in the horizontal position, not less than 1.5 m apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 13 mm globe valves and 8 mm gauge connection tee arranged in accordance with NFPA 20. One of the test connections shall be equipped with a 0 to 2100 kPa water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

2.11 DIESEL FUEL SYSTEM EXTERNAL TO ENGINE

Fuel system shall be provided that meets all requirements and advisory provisions of NFPA 20 and NFPA 37. The fuel tank vent piping shall be equipped with screened weatherproof vent cap. Vents shall be extended to the outside. Each tank shall be equipped with a fuel level gauge.

Flexible bronze or stainless steel piping connectors with single braid shall be provided at each piping connection to the diesel engine. Supply, return, and fill piping shall be steel piping, except supply and return piping may be copper tubing. Fuel lines shall be protected against mechanical damage. Fill line shall be equipped with 16 mesh removable wire screen. Fill lines shall be extended to the exterior. A weatherproof tank gauge shall be mounted on the exterior wall near each fill line for each tank. The fill



cap shall be able to be locked by padlock. The engine supply (suction) connection shall be located on the side of the fuel tank so that 5 percent of the tank volume provides a sump volume not useable by the engine. The elevation of the fuel tank shall be such that the inlet of the fuel supply line is located so that its opening is no lower than the level of the engine fuel transfer pump. The bottom of the tank shall be pitched 21 mm/m to the side opposite the suction inlet connection, and to an accessible 25 mm plugged globe drain valve.

2.11.1 Steel pipe

ASTM A 53/A 53M, hot-dipped zinc-coated, Schedule 40, threaded connections. Fittings shall be ASME B16.3, zinc-coated, threaded malleable iron fittings. Unions shall be ASME B16.39 zinc-coated, threaded unions.

2.11.2 Copper Tubing

ASTM B 88M ASTM B 88, Type K, soft annealed, with ASME B16.26 flared fittings .

2.11.3 Diesel Fuel Tanks

UL 80 or UL 142 for aboveground tanks .

2.11.4 Valves

An indicating and lockable ball valve shall be provided in the supply line adjacent to the tank suction inlet connection. A check valve shall be provided in fuel return line. Valves shall be suitable for oil service. Valves shall have union end connections or threaded end connections.

- a. Globe valve: MSS SP-80 Class 125
- b. Check valve: MSS SP-80, Class 125, swing check
- c. Ball valve: Full port design, copper alloy body, 2-position lever handle .

2.12 JOINTS AND FITTINGS FOR COPPER TUBE

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 862 kPa service and shall be the product of the same manufacturer.

Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536.

Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 110 degrees C Grooved joints shall conform to AWWA C606 Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

2.13 PUMP BASE PLATE AND PAD





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A common base plate shall be provided for each horizontal-shaft fire pump for mounting pump and driver unit. The base plate shall be constructed of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Each base plate for the horizontal fire pumps shall be provided with a 25 mm galvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Pump units and bases shall be mounted on a raised 150 mm reinforced concrete pad that is an integral part of the reinforced concrete floor .

2.14 FLOW METER

Meter shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b as flow meters for fire pump installation with direct flow readout device. Flow meter shall be capable of metering any waterflow quantities between 50 percent and 150 percent of the rated flow of the pumps. The flow meter shall be arranged in accordance with Figure A-2-14.2.1 of NFPA 20. The meter throttle valve and the meter control valves shall be O.S.&Y. valves. Automatic air release shall be provided if flow meter test discharge is piped to the pump suction and forms a closed-loop meter arrangement as defined in Figure A-2-14.2.1 of NFPA 20.





**CMW GENERAL SPECIFICATION
DIVISION 21**

Section: 21 30 00 FIRE PUMPS

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the CMW site engineer of any discrepancy before performing any work.

3.2 FIRE PUMP INSTALLATION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals, from the Contract Submittal Register, that relate to the successful installation of the fire pump(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to CMW.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall periodically perform a thorough inspection of the fire pump installation, including visual observation of the pump while running, to assure that the installation conforms to the contract requirements. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems.

Inspection shall include piping and equipment clearance, access, supports, and guards. Any discrepancy shall be brought to the attention of CMW Engineer in writing, no later than three working days after the discrepancy is discovered. The Fire Protection Specialist shall witness the preliminary and final acceptance tests and, after completion of the inspections and a successful final acceptance test, shall sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

3.4 INSTALLATION REQUIREMENTS

Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

Equipment, materials, workmanship, fabrication, assembly, erection, installation, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

3.5 PIPE AND FITTINGS

Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using tapered reducing pipe fittings. Bushings shall not be used

3.5.1 Cleaning of Piping

Interior and ends of piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.



3.5.2 Threaded Connections

Jointing compound for pipe threads shall be as per manufacturer instruction and shall be applied to male threads only. Exposed ferrous pipe threads shall be provided with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 0.025 mm.

3.5.3 Pipe Hangers and Supports

Additional hangers and supports shall be provided for concentrated loads in aboveground piping, such as for valves and risers.

3.5.3.1 Vertical Piping

Piping shall be supported at each floor, at not more than 3 meters intervals.

3.5.3.2 Horizontal Piping

Horizontal piping supports shall be spaced as follows:

MAXIMUM SPACING (METERS)											
Nominal Pipe Size	25 and Under (mm)	32	40	50	65	80	90	100	125	150+	
Copper Tube		1.8	2	2.4							
Steel Pipe		2	2.4	2.7	3	3.3	3.6	3.9	4.2	4.8	5.0

3.5.4 Underground Piping

Installation of underground piping and fittings shall conform to NFPA 24. Joints shall be anchored in accordance with NFPA 24. Concrete thrust block shall be provided at elbow where pipe turns up towards floor, and the pipe riser shall be restrained with steel rods from the elbow to the flange above the floor. After installation in accordance with NFPA 24, rods and nuts shall be thoroughly cleaned and coated with asphalt or other corrosion-retard material approved by CMW Engineer. Minimum depth of cover shall be 900 mm.





3.5.5 Grooved Mechanical Joint

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-band micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.6 ELECTRICAL WORK

Electric motor and controls shall be in accordance with NFPA 20, NFPA 72 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

3.7 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.8 FLUSHING

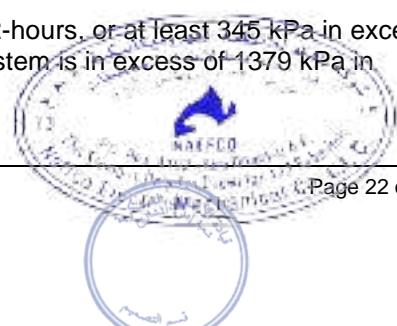
The fire pump suction and discharge piping shall be flushed at 150 percent of rated capacity of each pump. Where the pump installation consists of more than one pump, the flushing shall be the total quantity of water flowing when all pumps are discharging at 150 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. No underground piping shall be flushed by using the fire pumps. Flushing operations shall continue until water is clear, but not less than 10 minutes. Submit a signed and dated flushing certificate before requesting field testing.

3.9 FIELD TESTS

Submit, at least 2 weeks before starting field tests, system diagrams that show the layout of equipment, piping, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

3.9.1 Hydrostatic Test

Piping shall be hydrostatically tested at 1551 kPa for a period of 2-hours, or at least 345 kPa in excess of the maximum pressure, when the maximum pressure in the system is in excess of 1379 kPa in accordance with NFPA 20.





3.9.2 Preliminary Tests

The Fire Protection Specialist shall take all readings and measurements.

The Manufacturer's Representative, a representative of the fire pump controller manufacturer, and a representative of the diesel engine manufacturer shall witness the complete operational testing of the fire pump and drivers. The fire pump controller manufacturer's representative and the diesel engine manufacturer's representative shall each be an experienced technician employed by the respective manufacturers and capable of demonstrating operation of all features of respective components including trouble alarms and operating features.

Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed.

Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with CMW Engineer during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated.

3.9.3 Final Acceptance Test

The Fire Protection Specialist shall take all readings and measurements.

The Manufacturer's Representative, the fire pump controller manufacturer's representative, and the diesel engine manufacturer's representative shall also witness for the final tests. The Contractor shall be responsible for repairing any damage caused by hose streams or other aspects of the test. The final acceptance test shall include the following:

3.9.3.1 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment.

Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall taken on each phase as part of each flow test for electric-motor driven pumps.

3.9.3.2 Starting Tests

Pumps shall be tested for automatic starting and sequential starting.

Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20.

Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of a least 10 minutes for each of the starts; except that electric motors over 149 kW shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours. Pressure settings that include automatic starting and stopping of the fire pump(s) shall be indicated on an etched plastic placard, attached to the corresponding pump controller.



3.9.3.3 Battery Changeover

Diesel driven fire pumps shall be tested for automatic battery changeover in event of failure of initial battery units.

3.9.3.4 Alarms

All pump alarms, both local and remote, shall be tested. Supervisory alarms for diesel drivers shall be electrically tested for low oil pressure, high engine jacket coolant temperature, shutdown from overspeed, battery failure and battery charger failure.

3.9.3.5 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

3.9.3.6 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.9.3.8 Test Documentation

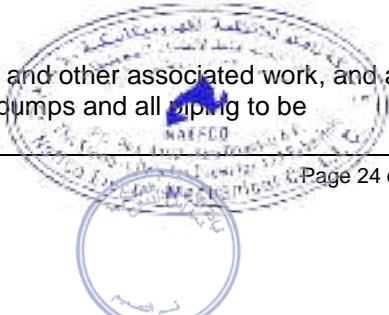
The Manufacturer's Representative shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Fire Protection Specialist shall record all test results and plot curve of each pump performance during the test. Complete pump acceptance test data of each fire pump shall be recorded. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20. All test data records shall be submitted in a three ring binder.

3.9.4 Test Equipment

Provide all equipment and instruments necessary to conduct a complete final test, including 65 mm diameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil filled water pressure gauges. Provide all necessary supports to safely secure hoses and nozzles during the test. The Contractor shall furnish water for the tests.

3.10 DISINFECTION

After all system components are installed including pumps, piping, and other associated work, and all hydrostatic tests are successfully completed, thoroughly flush the pumps and all piping to be





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disinfected with potable water until there is no visible sign of dirt or other residue. and hydrostatic test are successfully completed, each portion of the piping specified in this Section system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material.

3.10.1 Chlorination

The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system.

3.10.2 Flushing

The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by CMW Engineer.

3.10.3 Sample Testing

Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.11 FIELD TRAINING

The Fire Protection Specialist and the Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by CMW and Final user. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --





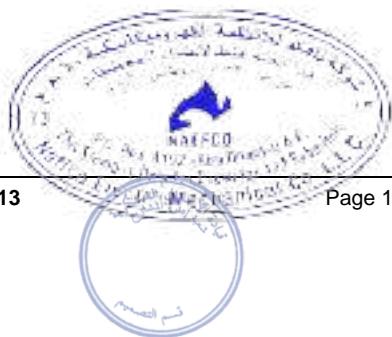
Section: 21 05 13 (COMMON MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT)

21 05 13

COMMON MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT

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Section: 21 05 13 (COMMON MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT)

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Architectural and Structural Specification sections apply to work of this section.
- B. Separate electrical components and materials required for field installation and electrical connections are specified in Division 26.

1.2 SCOPE OF WORK

- A. This Section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory installed motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are specified within the individual equipment specification sections, or are scheduled on the Drawings.

1.3 CODES AND STANDARDS

- A. Electrical components of mechanical equipment to conform to the following codes and standards:
- B. NEMA Standards MG1: Motors and Generators
- C. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies
- D. NEMA Standard 250: Enclosed Switches
- E. National Electrical Code (NFPA 70)
- F. Under Writer Laboratory (ul)
- G. Factory Mutual (FM)

1.4 1.04 MANUFACTURERS

- A. Obtain equipment and accessories from one of the following:

Westinghouse (U.S.A.)





Section: 21 05 13 (COMMON MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT)

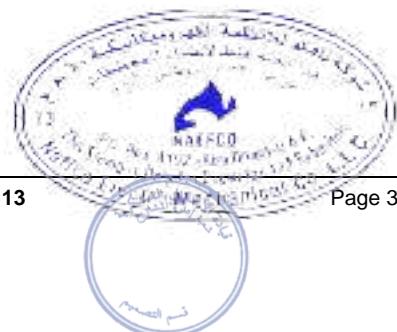
Square D	(U.S.A.)
General Electric	(U.S.A.)
Siemens	(Germany)
AEG	(Germany)
Klockner Moeller	(Germany)
English Electric	(U.K.)
AEI	(U.K.)
Ottermill	(U.K.)
Crabree	(U.K.)
Midland Electric Mfg. Co.	(U.K.)
GEC	(U.K.)
Newman	(U.K.)
Merlin Gerin	(France)

1.5 SUBMITTALS

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.6 QUALITY ASSURANCE

- A. A. Electrical components and materials to be UL labeled.



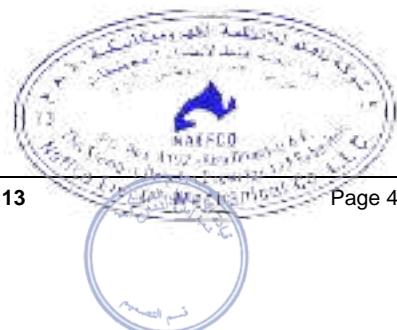


Section: 21 05 13 (COMMON MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT)

PART 2 PRODUCTS

2.1 ELECTRIC MOTORS

- A. Motors to be supplied by driven equipment manufacturer, to be as specified for equipment concerned and specifically supplied for available supply voltage and frequency.
- B. Motors 1/2 horsepower and under to be single phase and over 1/2 horsepower to be three phase. Motors to be totally enclosed, fan cooled type, unless otherwise specified.
- C. Motors to have Class F insulation with 120 deg. C continuous temperature rise above average ambient temperature of 50 deg. C, unless otherwise specified.
- D. Motors that will operate outdoors are to have Class F insulation.
- E. Motors operating in ambient temperatures of 50 deg. C and above to be tropicalized and derated for satisfactory operation.
- F. Motors to be rated for continuous operation with service factor of 1.15
- G. POWER to be adequate to operate driven equipment without motor overload under all operating conditions and loads and throughout capacity range of equipment. Motor to be capable of delivering full rated output when operating at voltage deviating by 5% from rated voltage at rated frequency.
- H. Starting AND Torque Characteristics to be as required by driven equipment.
- I. Speed to be as specified for equipment concerned.
- J. Conduit Terminal Box on Motor to be approved model for type of motor enclosure. Motor windings to be connected to terminals in terminal box at factory. One additional earthing terminal to be connected to motor frame.
- K. Motor Base to be adjustable where motors are directly connected to driven equipment, unless otherwise specified. Motors connected to equipment through V-belt drive to have adjustable sliding base. Fractional horsepower motors to have slotted mounting holes in base



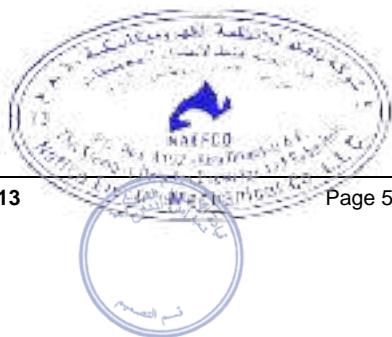
**CMW GENERAL SPECIFICATION
DIVISION 21**



Section: 21 05 13 (COMMON MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION _21 05 13





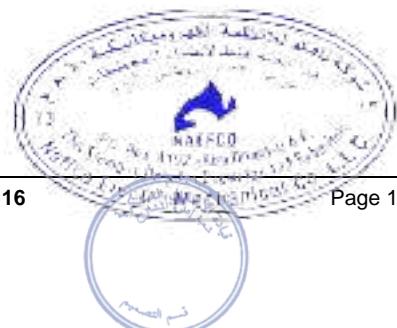
Section: 21 05 16 (EXPANSION FITTINGS AND LOOPS FOR FIRE SUPPRESSION PIPING)

21 05 16

**EXPANSION FITTINGS AND LOOPS FOR FIRE – SUPPRESSION
PIPING**

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Section: 21 05 16 (EXPANSION FITTINGS AND LOOPS FOR FIRE SUPPRESSION PIPING)

PART 1 GENERAL

1.1 RELATED DOCUMENTS

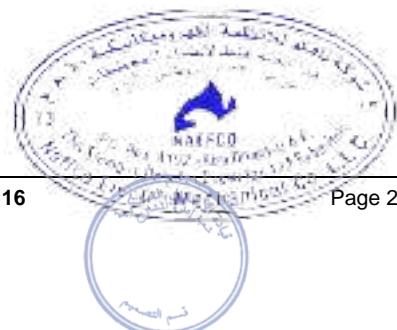
- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. SUMMARY
- C. This Section includes pipe expansion joints, guides, and anchors for mechanical piping systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Compatibility: Provide pipe expansion joints, pipe alignment guides, and pipe anchors suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Fabricate and install expansion and anchor system capable of sustaining forces generated by gravity, thermal movement, and seismic events.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of pipe expansion joint and pipe alignment guide specified.
- C. Pipe expansion joint schedule showing manufacturer's figure number, size, location, and features for each required expansion joint.
- D. Assembly-type shop drawings for each type of pipe expansion joint, pipe alignment guide, and anchor, indicating dimensions, weights, required clearances, and methods of component assembly.
- E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- F. Maintenance data for each type pipe expansion joint specified to include in the "Operating and Maintenance Manuals" specified in the Division 1 Section "Project Closeout".





Section: 21 05 16 (EXPANSION FITTINGS AND LOOPS FOR FIRE SUPPRESSION PIPING)

1.4 QUALITY ASSURANCE

- A. A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel".
 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".





Section: 21 05 16 (EXPANSION FITTINGS AND LOOPS FOR FIRE SUPPRESSION PIPING)

PRODUCTS

1.5 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:
1. Metal-Bellows, Packless-Type Pipe Expansion Joints:
 - a. Adesco Manufacturing Corp.
 - b. Anamet, Inc.
 - c. Badger Industries, Inc.
 - d. Hyspan Precision Products, Inc.
 - e. Keflex, Inc.
 - f. Metraflex Co.
 - g. Pathway Bellows, Inc., Dover Corp.
 - h. Piping Technology & Products, Inc.
 - i. Proco Products, Inc.
 - j. Senior Flexonics Inc., Expansion Joint Div.
 - B. Expansion-Compensator, Packless-Type Pipe Expansion Joints:
 1. Adesco Manufacturing Corp.
 2. Hyspan Precision Products, Inc.
 3. Keflex, Inc.
 4. Metraflex Co.
 5. Senior Flexonics Inc., Expansion Joint Div.
 - C. Slip-Type Pipe Expansion Joints:
 1. Adesco Manufacturing Corp.
 2. Advanced Thermal Systems, Inc.
 - D. Ball-Type Pipe Expansion Joints:
 1. Advanced Thermal Systems, Inc.
 2. Barco Div., Marison Industries.
 - E. Coupling, Grooved-Piping-Type Pipe Expansion Joints:
 1. Grinnell Corp., Pipe Supports Div.
 2. Gustin-Bacon Div., Tyler Pipe Subsid., Tyler Corp.
 3. Stockham Valves & Fittings, Inc.
 4. Victaulic Company of America.
 - F. Slip-Joint, Grooved-Piping-Type, Pipe Expansion Joints:
 1. Victaulic Company of America.
 - G. Pipe Alignment Guides:
 1. Adesco Manufacturing Corp.





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2. Advanced Thermal Systems, Inc.
3. B-Line Systems, Inc.
4. Grinnell Corp., Pipe Supports Div.
5. Hyspan Precision Products, Inc.
6. Keflex, Inc.
7. Metraflex Co.

1.6 PIPE EXPANSION JOINTS, GENERAL

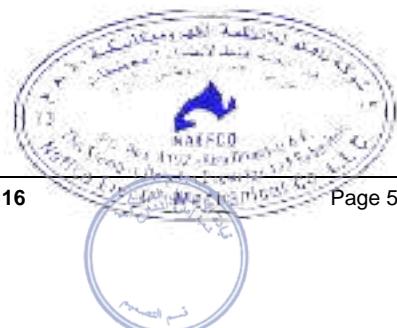
- A. Capability: Absorb 200 percent of maximum piping expansion between anchors.
- B. Refer to "Pipe Expansion Joint Schedule" for criteria of individual pipe expansion joints.
- C. Pipe expansion joint pressure ratings shall be compatible with piping system where system pressures require PN 16 or PN 32 components. This applies to all the following joint types.

1.7 PACKLESS-TYPE PIPE EXPANSION JOINTS

- A. Metal-Bellows Packless-Type Pipe Expansion Joints: Pressure rated for 2070 kPa minimum; conform to the standards of Expansion Joint Manufacturers Association, Inc. (EJMA); with end fittings and external tie rods for limiting maximum travel. Features include the following:
 1. Copper Piping Systems: 2 ply phosphor-bronze bellows and brass shrouds.
 2. Steel Piping Systems: 2 ply stainless-steel bellows and carbon-steel shrouds.
- B. Expansion-Compensator Packless-Type Pipe Expansion Joints: Pressure rated for 3200 kPa minimum. Include 2 ply phosphor bronze bellows, brass shrouds, and end fittings for copper piping systems and 2 ply stainless-steel bellows, carbon-steel shrouds, and end fittings for steel piping systems. Include internal guides, antitorque device, and removable end clip for proper positioning.

1.8 SLIP-TYPE PIPE EXPANSION JOINTS

- A. Carbon-steel packing-type expansion joint designed for repacking under pressure. Include limit stops, flanged or weld ends to match piping system, and drip connection where used for steam piping systems.
 1. Joint Packing: Asbestos-free polytetrafluoroethylene (PTFE) compound.
 2. Pressure Rating: 2070 kPa minimum at 204 deg C minimum.





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1.9 BALL-TYPE PIPE EXPANSION JOINTS

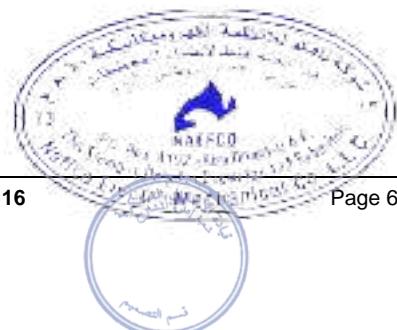
- A. General: Designed for 360 degree (6.3rad) rotation and minimum of 30 degree (0.52rad) angular deflection for sizes 150 mm and smaller and 15 degree (0.26rad) for sizes 200 mm and larger.
- B. Carbon steel and comply with ASME "Boiler and Pressure Vessel Code", Section II "Materials Specifications" and ASME B31.9 "Building Services Piping" for materials and design of pressure containing parts and bolting.
 - 1. Packing: Asbestos-free composition.
 - 2. Pressure Rating: 2070 kPa minimum at 204 deg C minimum.
 - 3. Factory Test: Test before shipment with steam at working pressure of piping system with no leaks.

1.10 GROOVED-PIPING-TYPE PIPE EXPANSION JOINTS

- A. Coupling: ASTM A 53, cut-grooved, short, steel-pipe nipples, and ductile-iron or malleable-iron shouldered couplings. Include removable ties to hold joint compressed or expanded during piping fabrication. Include suitable gasket materials for piping system.
- B. Slip-Joint: ASTM A 53, steel-pipe body; polytetrafluoroethylene (PTFE), modified-polyphenylene-coated steel-pipe slide; and ductile-iron or malleable-iron housing. Include suitable gasket material for piping system.

1.11 PIPE ALIGNMENT GUIDES

- A. Factory-fabricated cast semisteel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base. Include two-section guiding spider that bolts tightly to the pipe.
 - 1. Alignment Guide Lengths: As required for indicated travel.

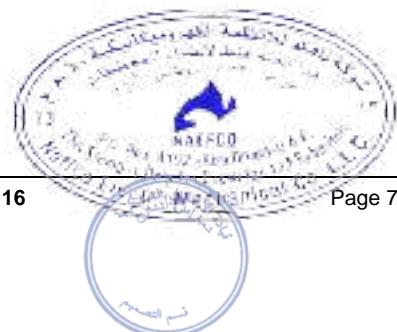




Section: 21 05 16 (EXPANSION FITTINGS AND LOOPS FOR FIRE SUPPRESSION PIPING)

1.12 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, traand nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Power-Actuated Fasteners: Attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- E. Concrete: Portland-cement mix, (20.7 MPa).
 - 1. Cement: ASTM C 150, Type I.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- F. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.
 - 1. Characteristics include post-hardening volume-adjusting dry hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
 - 2. Design Mix: (34.5 MPa), 28 day compressive strength.
 - 3. Water: Potable.
 - 4. Packaging: Premixed and factory-packaged.





Section: 21 05 16 (EXPANSION FITTINGS AND LOOPS FOR FIRE SUPPRESSION PIPING)

PART 2 EXECUTION

2.1 EXAMINATION

- A. Examine substrates and conditions under which pipe expansion joints, pipe alignment guides, and pipe anchors are to be installed. Do not proceed until unsatisfactory conditions have been corrected.

2.2 PIPE EXPANSION JOINT INSTALLATION

- A. Install pipe expansion joints according to manufacturer's written instructions.
- B. Align expansion joints to avoid end-loading and torsional stress.

2.3 FABRICATED-TYPE PIPE EXPANSION COMPENSATION INSTALLATION

- A. Install pipe expansion loops cold-sprung in tension or compression as required to absorb 50 percent of total compression or tension that will be produced during anticipated change in temperature.
- B. Connect risers to mains with at least 5 pipe fittings including tee in main.
- C. Connect risers to terminal units with at least 4 pipe fittings including tee in riser.

2.4 PIPE ALIGNMENT GUIDE INSTALLATION

- A. Install pipe alignment guides on piping that adjoins pipe expansion joints.
- B. Install pipe alignment guides on piping that adjoins pipe expansion loops.
- C. Install pipe alignment guides on piping elsewhere as indicated.
- D. Secure pipe alignment guides to building substrate.

2.5 3.05 PIPE ANCHOR INSTALLATION

- A. Install pipe anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.





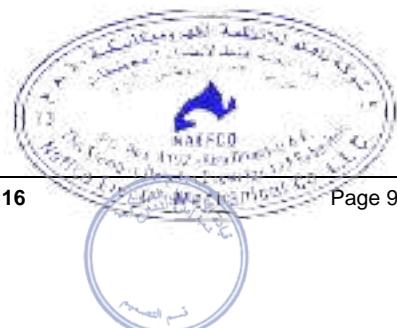
Section: 21 05 16 (EXPANSION FITTINGS AND LOOPS FOR FIRE SUPPRESSION PIPING)

- B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS D1.1.
- C. Construct concrete pipe anchors of poured-in-place concrete of dimensions indicated.
- D. Where pipe expansion joints are indicated, install pipe anchors according to expansion unit manufacturer's written instructions to control movement to compensators.
- E. Pipe Anchor Spacings: Where not otherwise indicated, install pipe anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Preset anchors as required to accommodate both expansion and contraction of piping.
- F. Use grout to form flat bearing surfaces for pipe expansion joints, pipe alignment guides, and pipe anchors that are installed on or in concrete.

2.6 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint and paint, exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9 Section "Painting".
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 21 05 16



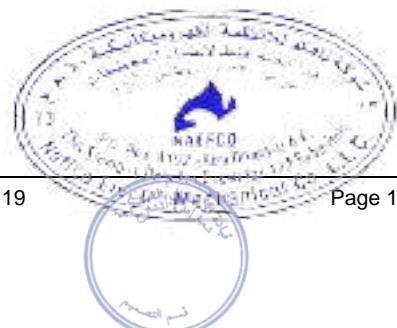


21 05 19

METERS AND GAGES FOR FIRE – SUPPRESSION SYSTEMS

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PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

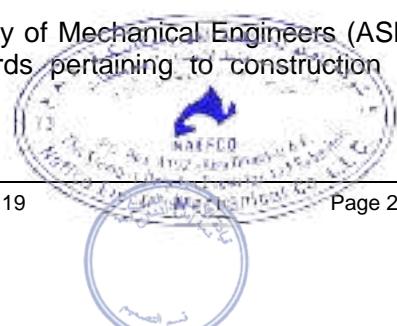
- A. This Section includes meters and gages used in mechanical systems.
- B. Related Sections: Division 21 piping Sections contain requirements that relate to this Section.
 - 1. Meters and gages furnished as part of factory-fabricated equipment are specified as part of the equipment assembly in other Division 21 Sections.
 - 2. Division 21 Section "Fire Pumps" for flow meters for testing fire pumps.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of meter, gage, and fitting specified. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit a meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
- C. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.
- D. Maintenance data to include in the "Operating and Maintenance Manuals" specified in Division 1 Section "Project Closeout". Include data for the following:
 - 1. Test plugs.
 - 2. Flow measuring systems.
 - 3. Flow meters.

1.4 QUALITY ASSURANCE

- A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.





PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Liquid-in-Glass Thermometers:
 - a. Marsh Instrument Co.
 - b. Marshalltown Instruments, Inc.
 - c. H.O. Trerice Co.
 - d. Weiss Instruments, Inc.
 - e. Weksler Instruments Corp.
 - B. Direct-Mounting Filled-System Dial Thermometers:
 1. Ashcroft Instrument Div. of Dresser Industries.
 2. Marsh Instrument Co.
 3. H.O. Trerice Co.
 4. Weiss Instruments, Inc.
 5. Weksler Instruments Corp.
 - C. Remote-Reading Filled-System Dial Thermometers:
 1. AMETEK, U.S. Gauge Div.
 2. Ashcroft by Dresser Industries, Instrument Div.
 3. Marsh Instrument Co.
 4. Tel-Tru Manufacturing Co., Inc.
 5. H.O. Trerice Co.
 6. Weiss Instruments, Inc.
 7. Weksler Instruments Corp.

2.2 BIMETAL DIAL THERMOMETERS:

- A. Ashcroft by Dresser Industries, Instrument Div.
- B. Marsh Instrument Co.
- C. Marshalltown Instruments, Inc.
- D. Reotemp Instrument Corp.
- E. Tel-Tru Manufacturing Co., Inc.
- F. H.O. Trerice Co.
- G. Weiss Instruments, Inc.
- H. Weksler Instruments Corp.

1. Pressure Gages:

- a. AMETEK, U.S. Gauge Div.
- b. Ashcroft by Dresser Industries, Instrument Div.



**CMW GENERAL SPECIFICATION
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Section: 21 05 19 (METERS AND GAGES FOR FIRE-SUPPRESSION SYSTEMS)

- c. Marsh Instrument Co.
 - d. Marshalltown Instruments, Inc.
 - e. H.O. Trerice Co.
 - f. Weiss Instruments, Inc.
 - g. Weksler Instruments Corp.
 - h. WIKA Instruments Corp.
2. Test Plugs:
- a. Flow Design, Inc.
 - b. MG Piping Products Co.
 - c. Peterson Equipment Co., Inc.
 - d. Sisco Co., Spedco, Inc.
 - e. H.O. Trerice Co.
 - f. Watts Regulator Co.
3. Venturi-Type Flow Elements:
- a. Armstrong Pumps, Inc.
 - b. BIF by Leeds & Northrup.
 - c. Badger Meter, Inc.
 - d. Barco Div., Marison Industries.
 - e. Fischer & Porter Co.
 - f. Gerand Engineering Co.
 - g. Preso Industries, Ltd.
 - h. Victaulic Company of America.
4. Electromagnetic Flow Meters:
- a. ABB Kent-Taylor, Inc.
 - b. Brooks Instrument Div., Emerson Electric Co.
 - c. Dynasonics, Inc.
 - d. Fischer & Porter Co.
 - e. Johnson Yokogawa Corp.
 - f. Monitek Technologies, Inc.
 - g. Schlumberger Industries, Inc., Measurement Div.
 - h. Wallace & Tiernan, Inc.
5. Flow Indicators:
- a. Anderson by Dwyer Instruments, Inc.
 - b. Brooks Instrument Div., Emerson Electric Co.
 - c. Ernst Gage Co.
 - d. Ketema, Inc., Schutte and Koerting Div.
 - e. Penberthy, Inc.
 - f. Visi-Flo by OPW Div., Dover Corp.

2.3 PRESSURE GAGES

- A. Description: ASME B40.1, Grade A phosphor-bronze Bourdon-tube pressure gage, with bottom connection.





- B. Case: Drawn steel, brass, or aluminum with 115 mm (4-1/2") diameter glass lens.
- C. Connector: Brass, 6 mm (1/4") NPS.
- D. Scale: White-coated aluminum, with permanently etched markings.
- E. Accuracy: Plus or minus 1 percent of range span.

- F. Range: Conform to the following:
 - 1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure.
 - 2. Vacuum: 100 kPa of vacuum to 100 kPa of pressure.
 - 3. Fluids Under Pressure: 2 times operating pressure.

2.4 PRESSURE-GAGE ACCESSORIES

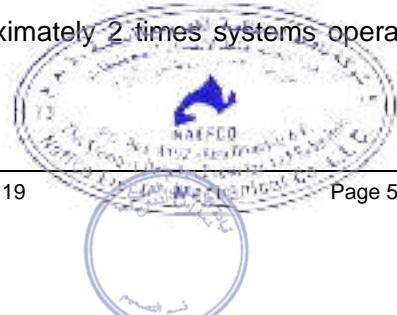
- A. Syphons: 6 mm straight coil of brass tubing with threads on each end.
- B. Snubbers: 6 mm brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.5 2.04 TEST PLUGS

- A. Description: Nickel-plated brass-body test plug in 15 mm fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 3450 kPa (500 psig) minimum.
- D. Core Inserts: 2 self-sealing valve types, suitable for inserting a 3 mm outside-diameter probe from a dial thermometer or pressure gage.

- E. Core Material: According to the following for fluid and temperature range:
 - 1. Air, Water, Oil, and Gas: Minus 7 to 93 deg C , neoprene rubber.
 - 2. Air and Water: Minus 35 to 136 deg C, ethylene-propylene-diene-terpolymer (EPDM) rubber.

- F. Test-Plug Cap: Gasketed and threaded cap, with retention chain.
- G. Test Kit: Provide test kit consisting of 1 pressure gage and gage adapter with probe, 2 bimetal dial thermometers and a carrying case.
- H. Pressure Gage and Thermometer Ranges: Approximately 2 times systems operating conditions.





2.6 2.05 FLOW-MEASURING SYSTEMS, GENERAL

- A. Flow-measuring systems include calibrated flow element, separate meter, hoses or tubing, valves, fittings, and conversion chart that is compatible with flow element, meter, and system fluid.
- B. Flow range of flow-measuring element and meter covers operating range of equipment or system where used.

2.7 2.06 FLOW-MEASURING METERS

- A. Permanent Meters: Suitable for mounting on wall or bracket, 150 mm dial or equivalent with fittings and copper tubing for connecting to flow element.
 - 1. Scale: In L/s (gallons/minute) unless otherwise indicated.
 - 2. Accuracy: Plus or minus 1 percent between 20 to 80 percent of range.
- B. Include complete operating instructions with each meter.

2.8 METERS

- A. Fire Pump Test Meters shall be Fire Pump Test Meter, Factory Mutual Approved, incorporating a calibrated venturi and attached GPM meter, to be installed on the discharge side of the fire pump, to accurately measure pump performance. Test Meter shall be supplied with grooved ends for installation with grooved end couplings.





PART 3 EXECUTION

3.1 METER AND GAGE APPLICATIONS

- A. General: Where indicated, install meters and gages of types, sizes, capacities, and with features indicated.

3.2 METER AND GAGE INSTALLATION, GENERAL

- A. Install meters, gages, and accessories according to manufacturers' written instructions for applications where used.

3.3 PRESSURE GAGE INSTALLATION

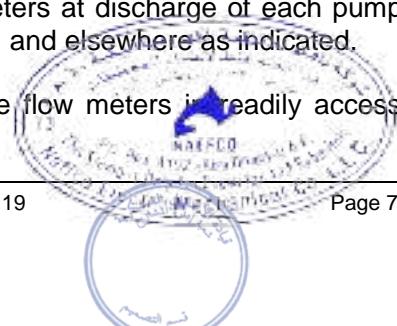
- A. Install pressure gages in piping tee with pressure gage valve located on pipe at most readable position.
- B. Install in the following locations and elsewhere as indicated:
 1. At suction and discharge of each pump.
 2. At discharge of each pressure-reducing valve.
- C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon instead of snubber for steam pressure gages.

3.4 TEST PLUG INSTALLATION

- A. Install test plugs in piping tees where indicated, located on pipe at most readable position. Secure cap.

3.5 FLOW-MEASURING SYSTEM, FLOW ELEMENT AND METER INSTALLATION

- A. General: Install flow meters for piping systems located in accessible locations at most readable position.
- B. Locations: Install flow measuring elements and meters at discharge of each pump, at inlet of each hydronic coil in built-up central systems, and elsewhere as indicated.
- C. Install connection fittings for attachment to portable flow meters in readily accessible locations.





- D. Permanently Mounted Meters for Flow Elements: Install meters on walls or brackets in accessible locations.
- E. Install connections, tubing, and accessories between flow elements and meters as prescribed by manufacturer's written instructions.

3.6 FLOW METER INSTALLATION

- A. Include 10 pipe diameters upstream and 5 pipe diameters downstream of straight unrestricted piping for 32 mm and smaller pipe. Include 20 pipe diameters upstream and 10 pipe diameters downstream for 40 mm and larger pipe.

3.7 CONNECTIONS

- A. Piping installation requirements are specified in other Division 21 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties.
- B. Install meters and gages adjacent to machines and equipment to allow servicing and maintenance.
- C. Connect flow-measuring-system elements to meters.
- D. Connect flow-meter transmitters to meters.
- E. Make electrical connections to power supply and electrically operated meters and devices.

3.8 ADJUSTING AND CLEANING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.
- C. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 21 05 19





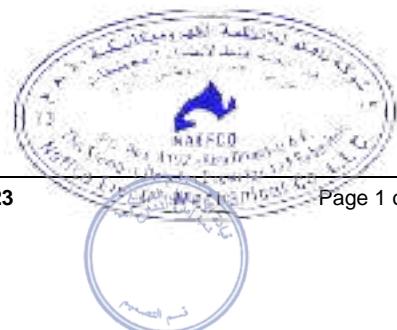
Section21 05 23 (GENERAL DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING)

21 05 23

GENERAL – DUTY VALVES FOR WATER – BASED FIRE – SUPPRESSION PIPING

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Section21 05 23 (GENERAL DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING)

PART 1 GENERAL

1.1 1.01 RELATED DOCUMENTS

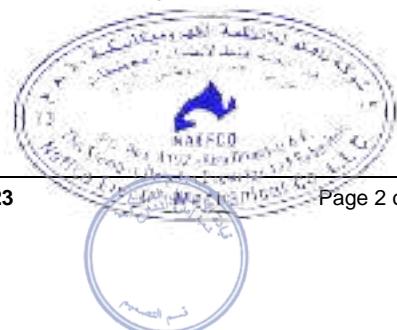
- A. Division-1 Specification sections apply to work of this section.
- B. Division-21 Section 210500 "Common Work Results For Fire Suppression" apply to work of this section.

1.2 1.02 SCOPE OF WORK

- A. Extent of General-Duty Valves for fire protection work is indicated on Drawings and schedules, and by requirements of this section.
- B. Installation of valves, sized to meet the system flow and pressure per NFPA 14.
- C. Installation of valves for the proper operation of the system as per NFPA 13.
- D. Engage a fire fighting designer approved by Civil Defence to assist in preparation of fire fighting scheme and location of valves and obtaining Civil Defence approval.
- E. Include cost for all necessary works related to Civil Defence approvals whether shown on document or not, include for inspection and obtaining completion certificate.

1.3 1.03 CODES AND STANDARDS

- A. NFPA Compliance: Install fire protection systems in accordance with the following NFPA Standards:
- B. Standards for the Installation of Standpipe and Hose Systems NFPA 14.
- C. Standard for the Installation of Sprinkler Systems NFPA 13.
- D. National Electrical Code - NFPA 70.
- E. UL Compliance: Provide fire protection products in accordance with UL standards; provide UP label on each product.
- F. FM (Factory Mutual) Compliance: Provide fire protection products and installations in accordance with FM standards and approved for 300 psi working pressure; provide FM label on each product.



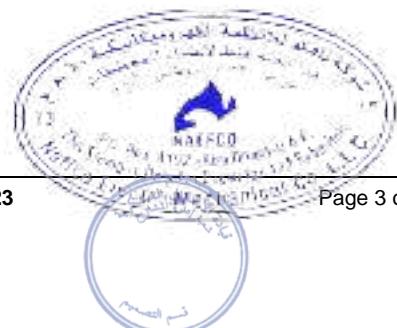


Section21 05 23 (GENERAL DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING)

- G. Fire Department/Marshal Compliance: All material and equipment necessary to meet the requirements of codes and the requirements of the local fire authorities are to be provided regardless of failure to specifically mention same in this Section or to show on Drawings.
- H. Screw Thread Connections: Comply with local Fire Department regulations for sizes, threading and arrangement of connections for fire department equipment to fire protection systems.

1.4 1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for fire protection materials and products. Manufacturer's literature and data sheets are to be submitted indicating the necessary installation dimensions, weights, materials and performance information. The performance is to include capacities, pressure drop, design and operating pressure, temperatures, and similar data. Complete electrical data, including power conditions, and identifying types and numbers, to be included. Where pertinent, electrical diagrams are to be provided. Literature and data sheets may be provided by standard sales sheets marked to indicate the specific equipment provided.
- B. Maintenance Data: Submit operation and maintenance data and parts lists for fire protection materials and products. Include this data, product data, shop drawings, approval drawings, approval calculations, certificate of installation, and record drawings in maintenance manual; in accordance with requirements of Division 1. Contractor is to furnish data covering model, type and serial numbers, capacities, maintenance and operation of each item of equipment or apparatus. Operating instructions are to cover all phases of control.
- C. Valve Schedule: Furnish a printed schedule, in duplicate, describing each valve by number, giving locations and service for which used. System identification to be as stipulated in the other sections of these specifications. One copy of this schedule is to be mounted under glass in a simple black enamel steel frame and hung in the mechanical equipment room where directed. The other copy is to be submitted to the Engineer before completion of the work.
- D. Shop Drawings and Manufacturer's Literature: Submit shop drawings and manufacturers literature on fire protection system components, according to the following listing:
- E. Valve Supervisory Switches
- F. Valve and Hydraulically Calculated ID signs
- G. Manufacturers Installation Instructions for all equipment in brochure
 - 1. Other
 - a. Leak Test Certificates
 - b. Operation and Maintenance Instructions





Section21 05 23 (GENERAL DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING)

PART 2 PRODUCTS

2.1 MATERIALS AND PRODUCTS - GENERAL

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection to comply with installation requirements.
- B. Provide materials and products of sizes and types matching piping and equipment connections.
- C. Provide fittings of materials which match pipe materials used in fire protection systems.

2.2 BASIC IDENTIFICATION

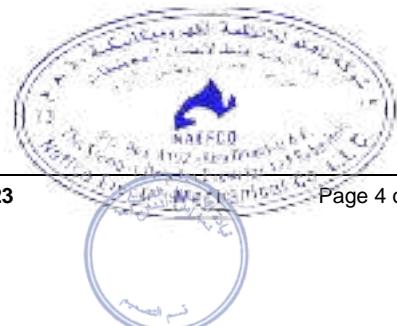
- A. Provide identification complying with Division-21 "Common Work Results for Fire Suppression".
- B. Fire Protection Signs: Provide the following signs:
 1. At each sprinkler valve, sign indicating what portion of system valve controls.
 2. At each outside alarm device, sign indicating what authority to call if device is activated.

2.3 BASIC VALVES-GROOVED END

A. Butterfly Valves

1. Shall be Underwriters Laboratories Listed for UL Butterfly Specification 1091 and Factory Mutual Approval Standard 1112, sizes 2-1/2" through 12" (DN65 through DN300), supplied with a ductile iron body conforming to ASTM A-395, GRADE 65-45-15, coated with a polyphenylene sulfide blend, a disc of ductile iron conforming to ASTM A-395, GRADE 65-45-15, with EPDM coating providing bubble tight shut-off. Sizes 2-1/2" through 12" (DN65 through DN300) shall have an approved weatherproof manual actuator suitable for indoor or outdoor use with two single pole, double throw supervisory switches either pre-wired (WRD) or unwired (UWD) monitoring the open position as specified on the drawings. Shall be supplied with grooved ends for installation with grooved end couplings and rated for service up to 300 psi (2065 kPa) working pressure. Valves shall be installed in accordance with the latest manufacturer's specifications.

B. Check Valves





Section21 05 23 (GENERAL DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING)

1. Shall be single disc, spring loaded, check valves 2 1/2"-12" (DN50-DN300), as Underwriters Laboratories Listed and Factory Mutual Approved for a single check and anti-water hammer service and for horizontal or vertical installation, supplied drilled, tapped and plugged downstream for drainage outlet with Grade "E" EPDM seal, housing cast of ductile iron conforming to ASTM A-395, GRADE 65-45-15, with grooved ends for installation with grooved end couplings rated for service up to 250 psi (1725 kPa) working pressure. For system subjects to more than 10 bar static head or pressure exceeds the 1725 kpa, use valve with 2400 kPa working pressure.

C. Ball Valves

1. Shall be sizes 2" through 3" (DN50 through DN80), Underwriters Laboratories Listed for UL Specification 1091 and Factory Mutual Approval Standard 1112, supplied with a ductile iron body conforming to ASTM A-395, GRADE 65-45-15, painted, and a ball conforming to Type 316 stainless steel. Shall be unsupervised or have factory installed double pole, double throw switches monitoring the open position as specified on the drawings. The valve should be with grooved ends to connect with grooved end couplings and rated for service up to 300 psi (2065 kPa) working pressure. Valves shall be installed in accordance with the latest published manufacturer specifications.

D. Alarm Check Valves

1. Shall be spring assisted Alarm Check Valves, as Underwriters Laboratories Listed and Factory Mutual Approved, for vertical installation, supplied with Grade "E" EPDM clapper seal, housing cast of ductile iron conforming to ASTM A-395, GRADE 65-45-15, serviceable without removal from the line, with grooved 1 1/2"-6" (DN40 - DN150) or flange by groove 4"-6" (DN100-DN150) ends for installation with ANSI Class 150 flange or manufacturer grooved end couplings as applicable, rated for service up to 300 psi (2065 kPa) working pressure.

E. Actuated Check Valve with Deluge Trim

1. Shall be of low differential, latched closed spring assisted, self resetting clapper, pneumatic, hydraulic, or electric release, Actuated Check Valve with Deluge Trim as Underwriters Laboratories, Listed and Factory Mutual Approved, for vertical installation, supplied with Grade "E" EPDM clapper seal, housing cast of ductile iron conforming to ASTM A-395, GRADE 65-45-15, serviceable without removal from the line, with grooved 1-1/2"-6" (DN40-DN150) or flange by groove 4"-6" (DN100-DN150) ends for installation with ANSI Class 150 flange or manufacturer grooved end couplings as applicable, rated for service up to 300 psi (2065 kPa) working pressure.

F. Actuated Check Valve with Pre-Action Trim

1. Shall be of low differential, latched closed spring assisted, self resetting clapper, pneumatic or electric release, non, single, or double interlock Actuated Check Valve with Pre-Action Trim as Underwriters Laboratories Listed and Factory Mutual



Section21 05 23 (GENERAL DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING)

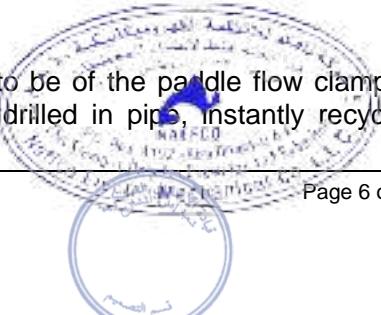
Approved, for vertical installation, supplied with Grade "E" EPDM clapper seal, housing cast of ductile iron conforming to ASTM A-395, GRADE 65-45-15, serviceable without removal from the line, with grooved 1 1/2"-6" (DN40-DN150) or flange by groove 4"-6" (DN100-DN150) ends for installation with ANSI Class 150 flange or grooved end couplings as applicable, rated for service up to 300 psi (2065 kPa) working pressure.

2.4 SPECIAL VALVES

- A. Provide valves, UL-listed, where indicated, in accordance with the following listing. Provide sizes and types which mate and match piping and equipment connections.
- B. Detector Check Valves: Detector check valves to be galvanized cast iron detector check with bronze bypass meter with gate and check valves, and weighted flapper and flanged ends. Provide Hersey-Sparling Meter Co. No. DC, Grinnell Fig. 1371, or Viking Model C-2.
- C. Backflow Preventers: Backflow preventers to be reduced pressure type, consisting of two spring-loaded check valves and a spring-loaded, diaphragm actuated, differential pressure relief valve located between the check valves. Unit to be galvanized cast iron. Unit to be as manufactured by, or approved equal:
- D. Cla-Val Co., Model RP
- E. Hersey Products, Equivalent
- F. Watts Regulator Co., Equivalent
- G. Alarm Check Valves: Alarm check valves to be flanged units complete with gauges and accessories piped to unit, retarding chamber, and less water motor alarm and outside gong. Provide Grinnell Model A. Standard alarm trimming to include electric outlet for alarm connection.
- H. Deluge Valves: Deluge valves to be flanged units complete with trim package and water gauges, diaphragm bypass, emergency release panels, dehydrator, and air maintenance device accessories. Provide Viking Model D-5. Standard alarm trimming to include electric pressure alarm switch for alarm connection.

2.5 FIRE PROTECTION SPECIALTIES

- A. A. Provide fire protection specialties, UL-listed, in accordance with the following listing. Provide sizes and types which mate and match piping and equipment connections.
- B.
- C. B. Water Flow Indicators: Water flow indicators to be of the paddle flow clamp-on type with vane projecting into pipe through a hole drilled in pipe, instantly recycling





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operation on 110 volt, single phase, 50 hertz service, with contacts for connection to alarm center. Water flow indicators to be as manufactured by, or approved equal:

1. Grinnell, Model F-620
2. Autocall, Type WF5
3. Potter

D. C. Alarm Bells: Provide alarm bell at each waterflow indicator and at central location where indicated. Bells to be 150 mm size unless otherwise indicated, single stroke or vibrating type as required by the service, and are to operate on 110 volts, single phase, 50 hertz. Alarm bells to be as manufactured by, or approved equal:

1. Edwards Co.
2. Autocall Co.
3. Kidde Ultrasonic and Detection Alarms

E. D. Water-Motor Gongs: Provide where indicated, and for each alarm check valve 250 mm weatherproof, red enameled finish, water-motor gongs.

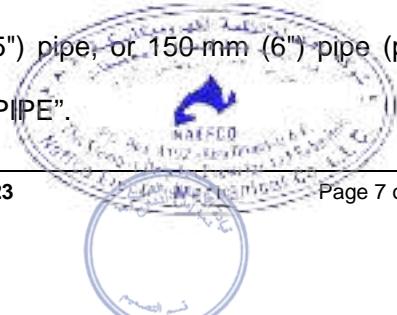
F. E. Supervisory Switches: Provide UL-listed tamper switches for each sprinkler, standpipe and fire pump control valve or where indicated, arranged to detect the open or closed position of control valves and to be connected to the fire alarm system. Standpipe hose valves and test and drain valves shall not be provided with supervisory switches. Switches to be attached to the various control valves being supervised and to be complete with tamper switches, required trim and electrical characteristics compatible with those of the fire alarm system. Switch housing to be finished in red baked enamel Supervisory switches to be as manufactured by, or approved equal:

1. Faraday
2. Temptron
3. Honeywell
4. Simplex
5. Potter

2.6 2.06 SIAMESE CONNECTIONS

A. Wall Type Siamese Connections: Provide where indicated, wall type cast brass flush Siamese connections and escutcheon plate assembly, with two, 65 mm fire department inlets with female hose connections, fire hose connection screw thread adapted to locally used hoses, equipped with individual drop clapper valves, equipped with plugs and chains, construction features as indicated, and constructed with the following additional construction features:

1. Finish: Chrome plate.
2. Inlet Pipe: 100 mm (4") pipe, 125 mm (5") pipe, or 150-mm (6") pipe (pipe size).
3. Cast Lettering: "AUTO. SPKR."/"STAND PIPE".



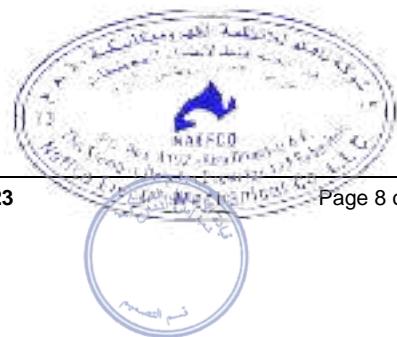


Section21 05 23 (GENERAL DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING)

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4. Escutcheon: 180 mm x 360 mm rectangular.
- B. Subject to compliance with requirements, provide siamese connections of one of the following manufacturers, or approved equal:
1. Potter-Roemer, 5206
 2. Elkhart Brass Mfg. Co. Equivalent
 3. Croke-Standard, Equivalent
 4. Sierra Fire Equipment Co., Equivalent
 5. J.W. Moon, Inc. Equivalent

2.7 ALARM TEST MODULE

- A. Test master
1. Threaded Outlet Alarm Test Module shall be (threaded) inlet and outlet, a combination sight glass/orifice, bronze top works and 1/4" NPT plug for attachment of a gauge water hose for pressure testing.





Section21 05 23 (GENERAL DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING)

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which fire protection materials and products are to be installed.

3.2 INSTALLATION OF BASIC IDENTIFICATION

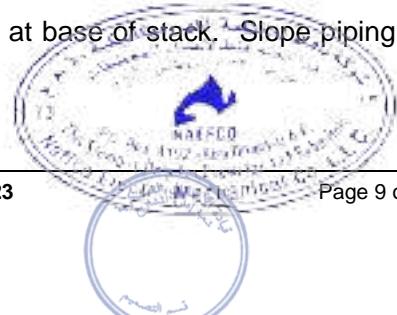
- A. Install mechanical identification in accordance with Division-21 Section 210553 "Identification for Fire- Suppression Piping and Equipment".
- B. Install fire protection signs on valves in accordance with NFPA 13 and NFPA 14 requirements.

3.3 INSTALLATION OF FIRE PROTECTION VALVES

- A. Comply with requirements of NFPA 13 and NFPA 14 for installation of fire protection piping materials.
- B. Install piping products where indicated, in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that piping systems comply with requirements and serve intended purposes.
- C. Install drain piping at low points of piping systems. Provide dry drum drips where required.
- D. Install sectional valves in inlet piping, at bottom of each riser, and in loops as indicated.
- E. Install water flow indicators where indicated. Mount supervisory switches on each sectional valve.
- F. Install Inspector's test connection where indicated, or at most remote point from riser.

3.4 INSTALLATION OF VALVES

- A. Provide valves on mains and branches for sectionalising the system for maintenance and operation and for flushing, draining and testing the system.
- B. Provide 50 mm drain valves of the globe valve type at base of stack. Slope piping not less than 2% towards drain valves.



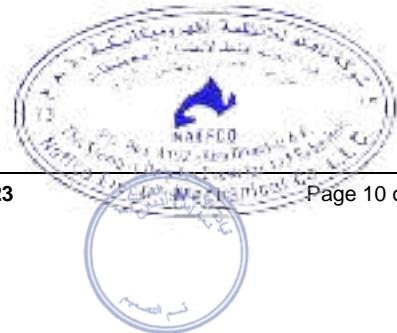
**CMW GENERAL SPECIFICATION
DIVISION 21**



Section21 05 23 (GENERAL DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING)

- C. Install alarm check valves on main water supply pipe to every fire fighting water distribution system at source of pressure. Install, test and adjust in accordance with manufacturer's instructions.
- D. Install detector check valves in horizontal position as indicated, orientated for proper flow direction. Install by-pass meter with globe valve and check valve, in accordance with manufacturer's installation directions.

END OF SECTION 21 05 23





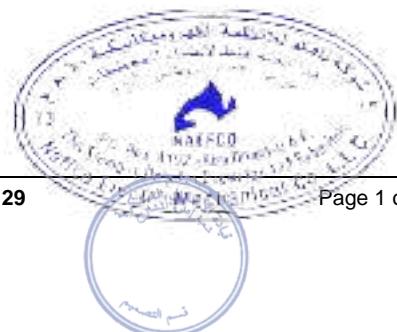
Section: 21 05 29 (HANGERS AND SUPPORT FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

21 05 29

HANGERS AND SUPPORTS FOR FIRE – SUPPRESSION PIPING AND EQUIPMENT

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Section: 21 05 29 (HANGERS AND SUPPORT FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

PART 1 GENERAL

1.1 1.01 RELATED DOCUMENTS

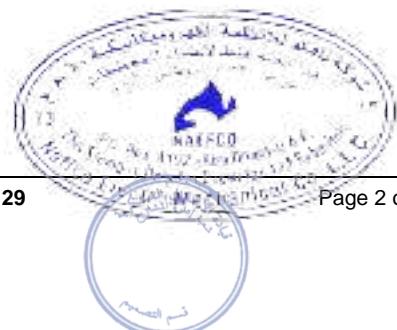
- A. A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical systems piping and equipment.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 1. Division 5 Section "Metal Fabrications" for materials for attaching hangers and supports to building structure.
 2. Division 21 Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment.
 3. Division 21 Section 211200 " Fire Suppression Stand Pipes" & Section 211300 "Fire Suppression Sprinkler Systems".
- C. Approved types of pipe hangers, supports and anchors are shown on the Drawings, and described in this section. Contractor may provide other types subject to approval by the Engineer.
- D. Pipe supports and anchors are to be provided following the requirements of this section and other Division-21 sections irrespective of whether they are indicated on the Drawings or not.

1.3 MSS STANDARD (MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTING INDUSTRY) COMPLIANCE

1. Terminology used in this Section is defined in MSS SP-90.
2. Provide pipe hangers and supports complying with MSS SP-58.
3. Select and apply pipe hangers and supports complying with MSS SP-69.
4. Fabricate and install pipe hangers and supports complying with MSS SP-89.





Section: 21 05 29 (HANGERS AND SUPPORT FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

1.4 SEISMIC PERFORMANCE REQUIREMENTS

- A. A. Design seismic restraint hangers and supports for piping and equipment suitable for seismic zone of project.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- C. Design and obtain approval from the Engineer for seismic restraint hangers and supports for piping and equipment suitable for seismic zone of the project. Upon application of seismic forces of computed intensity, piping shall remain fully connected into operable systems and shall not be displaced sufficiently to damage adjacent or connecting equipment, or building members. Thermal expansion flexibility shall not be impaired. Seismic rate shall be as follows:
 1. Project seismic zone is 2A with a zone factor of 0.15
 2. Building Importance Factor: 1.0
- D. All hangers and supports installation details and any cutting and drilling in structural elements shall be approved by the Engineer.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.
- B. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.





Section: 21 05 29 (HANGERS AND SUPPORT FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

PART 2 PRODUCTS

2.1 HANGERS AND SUPPORTS - GENERAL

- A. Hangers and supports are to allow adjustment of slope of piping and removal without dismantling pipes.
- B. Hangers and supports to be designed and tested to sustain load eight times actual supported load.
- C. Hangers and supports to be steel with smooth flat bearing surfaces, to carry weight of piping and contents without sagging, swaying, vibrating or deforming, and to allow free movement of pipes due to expansion and contraction without noise or damage to piping or construction.
- D. Hangers and supports to be complete with all necessary structural steel, rods, bolts, nuts, turnbuckles and other components.
- E. Select only one type by one manufacturer for each piping service.
- F. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping.
- G. Provide copper-plated hangers and supports for copper-piping systems.

2.2 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
 1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
 2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 690 kPa (100 psi) average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.



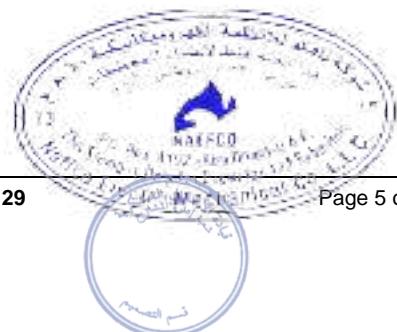


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- E. Pipe Anchor and Guides: 20 mm diameter U-bolts to fit around pipe loosely for guides and welded to pipe for anchors.

2.3 2.03 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.
 - 1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
 - 2. Design Mix: 34.5 MPa , 28-day compressive strength.
 - 3. Water: Potable.
 - 4. Packaging: Premixed and factory-packaged.





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PART 3 EXECUTION

3.1 3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.
- C. Install hangers and supports of same type and style as installed for adjacent similar piping.
- D. Do not use wire, rope, wood, chain, strap or perforated metal to support piping, and do not support piping from other piping.
- E. Hangers and supports in mechanical rooms including chiller hall and pump room floor to be spring type.

3.2 3.02 HANGER AND SUPPORT INSTALLATION

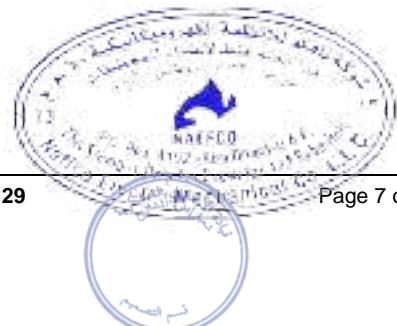
- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. Provide intermediate steel where required to transfer loads to areas of structure where they can be safely accommodated.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Keep pipes in position with U-bolts. Lines subject to extreme thermal expansion to be free to slide or roll. (Provide rollers on trapeze hangers)
- C. Install supports with maximum spacing complying with MSS SP-69, and the requirements of this section. Specified maximum spans are for straight runs of pipe.
- D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers. Support vertical pipe risers independently of adjacent horizontal hangers.
- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.





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- F. Install concrete inserts in new construction prior to placing concrete.
- G. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 100 mm thick.
- H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 100 mm thick or in post tensioned slabs.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supp. Weld steel according to AWS D-1.1.
- K. Support fire protection systems piping independent of other piping.
- L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment. Support piping independently of equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- O. Anchors: Weld U-bolts to pipes at points of contact and bolt to structural angle frame securely fixed to structure.
- P. Insulated Piping: Protect pipe insulation at hangers and supports from weight or movement of pipe. Provide firm attachment to pipe. Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
 - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - 3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields to span an arc of 180 degrees (3.1 rad) and have dimensions in mm not less than the following:





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PIPE SIZE Mm	LENGTH mm	THICKNESS Mm
□	□	
8 to 90□	300□	1.22□
100□	300□	1.52□
125 and 150□	450□	1.52□
200 to 350□	600□	1.91□
400 to 600□	600□	2.67□

4. 4. Pipes 200 mm and Larger: Include wood inserts.
5. Insert Material: Length at least as long as the protective shield.
6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

3.3 SPACING OF PIPE HANGERS AND SUPPORTS

A. Ductile Iron Pipe Supports:

1. Support ductile iron pipes with at least one support per length of pipe and at intervals not exceeding 3.5 m with hanger preferably located adjacent to joint.

B. Steel Pipe Supports:

1. Support horizontal steel pipes at intervals not exceeding maximum support spacing and by hanger rod of minimum size as follows:

PIPE DIAMETER (mm)	MAXIMUM SUPPORT SPACING (m)	MINIMUM SIZE OF HANGER ROD (mm)
15	1.5	10
20	1.8	10
25	2.0	10
32	2.5	10
40	2.7	10
50	3.0	10
65	3.3	13
80	3.6	13





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PIPE DIAMETER (mm)	MAXIMUM SUPPORT SPACING (m)	MINIMUM SIZE OF HANGER ROD (mm)
100	4.2	16
125	4.2	16
150	4.2	22
200	4.8	25
250	4.8	25
300	4.8	25
350	6.0	25
400	6.0	28
450	6.0	32
500	6.0	32
550	6.0	38
600	6.0	38

2. Support vertical steel pipes at a minimum of every storey height.

3.4 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment. and make a smooth bearing surface.

3.5 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and 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.





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4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

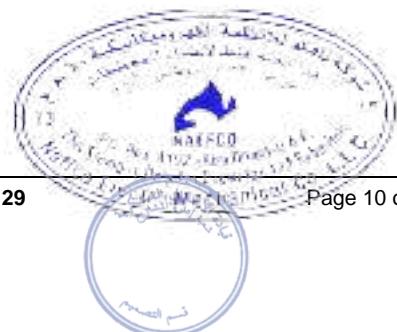
3.06 ADJUSTING

- D. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply by brush or spray to provide a minimum dry film thickness of 0.05 mm
- B. Touching Up: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9 Section "Painting".
- C. Galvanized Surfaces: Clean welds, bolted connections and abraded areas and apply galvanizing-repair paint to comply with ASTI A SC.

END OF SECTION 21 05 29



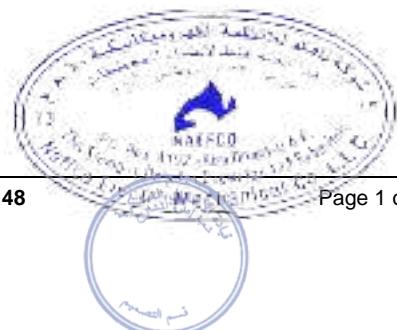


21 05 48

VIBRATION AND SEISMIC CONTROLS FOR FIRE – SUPPRESSION PIPING AND EQUIPMENT

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PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.
- B. Architectural layout and locations of sound related materials. Also site layout with respect to adjacent buildings.

1.2 SUMMARY

- A. Extent of vibration control work required by this section is indicated on Drawings and schedules, and/or specified in other Division 21 sections. Noise criteria, seismic restraints for equipment, vibration tolerance, and vibration isolation for HVAC and plumbing work.
- B. Types of vibration control products specified in this section include the following:
 1. Neoprene Pads.
 2. Vibration Isolation Springs.
 3. All-Directional Anchors.
 4. Neoprene Mountings.
 5. Spring Isolators, Vertically-Restrained.
 6. Thrust Restraints.
 7. Fabricated Equipment Bases.
 8. Inertia Base Frames.
 9. Isolation Hangers.
 10. Flexible Pipe Connectors.
- C. Vibration control products furnished as integral part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 21 sections.
- D. Refer to other Division 21 sections for equipment foundations, hangers, sealants, gaskets, and other work related to vibration control work.
- E. Refer to other Division 21 and 26 sections for requirements of electrical connections to equipment isolated on vibration control products.
- F. Refer to other Division 23 sections for requirements of duct connections to air handling equipment isolated on vibration control products.





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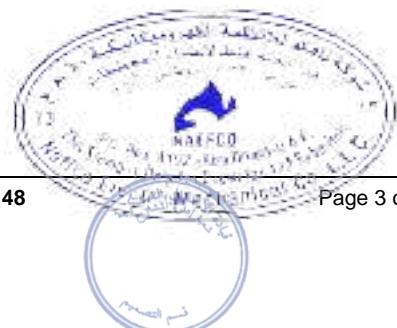
Section: 21 05 48 (VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION
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1.3 QUALITY ASSURANCE

- A. A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.
 1. Except as otherwise indicated, obtain vibration control products from single manufacturer.

1.4 NOISE CRITERIA:

- A. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed NC 35 within the occupied room, except as mentioned in the design guidelines.
 - B. For equipment which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the fore-going noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with ASHRAE 1999 HVAC Applications Handbook, Chapter 43, SOUND AND VIBRATION CONTROL. Cooling Tower shall not exceed 80 dB at 3 metre.
 - C. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.
 - D. In absence of specified measurement requirements, measure equipment noise levels one meter from equipment and at an elevation of maximum noise generation.
- E. Seismic Restraint Requirements:
1. For equipment:
 - a. All mechanical equipment shall be suitable for applications requiring equipment anchorage to resist seismic forces of Seismic Zone 2A, per the Uniform Building Code (UBC).
 - b. All mechanical equipment not supported with isolators external to the unit shall be securely anchored to the structure. Such mechanical equipment, shall be properly supported to resist a horizontal force of 20 percent of the weight of the equipment furnished
 - c. All mechanical equipment mounted on vibration isolators shall be provided with seismic restraints capable of resisting a horizontal force of 20 percent of the weight of the equipment furnished.
 - d. Mechanical Equipment: Mechanical equipment to be seismically protected shall include the following items to the extent required on the Drawings or in other Sections of the Specification:
 - i. Storage tanks for oil and water.
 - ii. Expansion air separator tanks.
 - iii. Valves and fittings for piping.
 - iv. Air compressors.





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e. 2. For piping:

- i. a. Mechanical Systems: The following mechanical systems shall be installed as required on the Drawings and other Sections of the Specification and shall be seismically protected in accordance with this Specification:
- 1) All Piping Inside the Building Except as Specifically Stated Below Under "Items Not Covered By This Section".
 - 2) Fuel piping outside of buildings.

F. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.

G. The contractor shall employ an Acoustic Consultant to ensure he meets the criteria.

1.5 1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished. Manufacturer's Literature shall include:

1. Vibration isolators:
 - a. Floor mountings.
 - b. Hangers.
 - c. Snubbers.
 - d. Thrust restraints.
2. Bases.
3. Seismic restraint provisions and bolting.
4. Acoustical enclosures.

B. Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.

C. Seismic Requirements: Submittals are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, standard connections, manufacturer's recommendations, behavior problems (vibration, thermal, expansion etc.) associated with equipment or piping

D. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Detail bases, and show location of equipment anchoring points coordinated with equipment manufacturer's shop drawings.

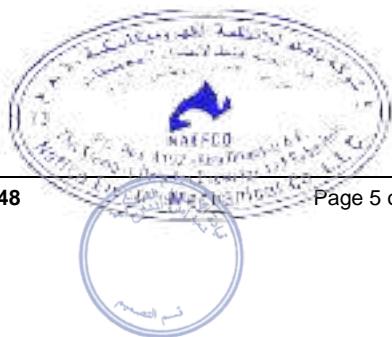


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- E. Maintenance Data: Submit maintenance data for each type of vibration control product. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.





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PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering vibration control products which may be incorporated in the work include, but are not limited to, the following:
1. Amber/Booth Co.
 2. Korfund Dynamics Corp.
 3. Kinetics Noise Control
 4. Mason Industries, Inc.
 5. Peabody Noise Control, Inc.
 6. Vibration Eliminator Co., Inc.
 7. Vibration Mountings and Controls, Inc.

2.2 VIBRATION CONTROL MATERIALS AND SUPPORTS UNITS

- A. General: Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements indicated in the schedule on the drawings.

2.3 VIBRATION ISOLATORS

- A. Hangers: Shall be combination neoprene and springs unless otherwise noted and shall allow for expansion of pipe.
1. Combination Neoprene and Spring (Type H): Vibration hanger shall contain a spring and double deflection neoprene element in series. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
 2. Spring Position Hanger (Type HP): Similar to combination neoprene and spring hanger except hanger shall hold piping at a fixed elevation during installation and include a secondary adjustment feature to transfer load to spring while maintaining same position.
 3. Neoprene (Type HN): Vibration hanger shall contain a double deflection type neoprene isolation element. Hanger rod shall be separated from contact with hanger bracket by a neoprene grommet.
 4. Spring (Type HS): Vibration hanger shall contain a coiled steel spring in series with a neoprene grommet. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel





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- of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
5. Hanger supports for piping 50 mm and larger shall have a pointer and scale deflection indicator.
- B. Snubbers: Each spring mounted base shall have a minimum of four all-directional or eight two directional (two per side) seismic snubbers that are double acting. Elastomeric materials shall be shock absorbent neoprene bridge quality bearing pads, maximum 60 durometer, replaceable and have a minimum thickness of 6 mm. Air gap between hard and resilient material shall be not less than 3 mm nor more than 6 mm. Restraints shall be capable of withstanding design load without permanent deformation.
- C. Thrust Restraints (Type THR): Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow a maximum movement of 6 mm when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

2.4 BASES

- A. Rails (Type R): Design rails with isolator brackets to reduce mounting height of equipment and cradle machines having legs or bases that do not require a complete supplementary base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension but not less than 100 mm (four-inches). Where rails are used with neoprene mounts for small fans or close coupled pumps, extend rails to compensate overhang of housing.
- B. Integral Structural Steel Base (Type B): Design base with isolator brackets to reduce mounting height of equipment which require a complete supplementary rigid base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension, but not less than 100 mm.
- C. Inertia Base (Type I): This applies to diesel generators, any floor mounted pumps and as shown on drawings. Base shall be a reinforced concrete inertia base. Pour concrete into a welded steel channel frame, incorporating prelocated equipment anchor bolts and pipe sleeves. Level concrete to provide a smooth uniform bearing surface for equipment mounting. Provide grout under uneven supports. Channel depth shall be a minimum of 1/12 of longest dimension of base but not less than 150 mm. Form shall include 13 mm reinforcing bars welded in place on minimum of 203 mm centers running both ways in a layer 40 mm above bottom. The whole assembly shall be supported on spring isolators carrying the base from brackets that keep the centre of gravity low. Use height saving brackets in all mounting locations. Weight of inertia base two to three the weight of equipment supported to provide a maximum peak-to-peak displacement of 2 mm. For pumps use wide enough base, so that the supports for the pipe connections are made on the base.
- D. Curb Mounted Isolation Base (Type CB): Fabricate from aluminum to fit on top of standard curb with overlap to allow water run-off and have wind and water seals which shall not interfere with spring action. Provide resilient snubbers with 6 mm clearance for wind resistance. Top and bottom bearing surfaces shall have sponge type weather seals. Integral spring isolators shall comply with Spring Isolator (Type 3) requirements.





2.5 GENERAL ISOLATOR REQUIREMENTS:

- A. Elastomeric isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness of 60 durometer and have a straight-line deflection curve.
- B. Exposure to Weather: Isolators, including springs, exposed to weather shall be hot-dip galvanized after fabrication. Hot-dip zinc coating shall be not less than 609 grams per square meter (two ounces per square foot) by weight complying with ASTM A123. In addition, provide limit stops to resist wind velocity. Comply with the design wind velocity for hurricane areas as per VA Construction Standard CD-54.
- C. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.
- D. Color code isolator by type and size for easy identification of capacity.

2.6 SEISMIC RESTRAINT REQUIREMENTS FOR EQUIPMENT

- A. Bolt pad mounted equipment, without vibration isolators, to the floor or other support using ASTM A307 standard bolting material; or, equal.
- B. Floor Mounted Equipment, With Vibration Isolators: Type SS. Where Type N isolators are used provide channel frame lease horizontal restraints bolted to the floor, or other support, on all sides of the equipment. Size and material required for the lease shall be as recommended by the isolator manufacturer.
- C. On all sides of suspended equipment, provide bracing for rigid supports and provide restraints for resiliently supported equipment. The slack cable restraint method, Mason Industries, or equal, is acceptable.
- D. Neoprene Pads: Oil-resistant neoprene sheets, of manufacturer's standard hardness and cross-ribbed or waffled pattern.
- E. Vibration Isolation Springs: Wound-steel compression springs, or high-strength spring alloy steel; with spring diameter not less than 0.8 of compressed height of spring at rated loads. Provide minimum additional travel to solid, equal to 50% of rated deflection. Provide spring wire with elastic limit stress exceeding at solid deflection.
- F. All-Directional Anchors: Provide all-directional acoustical pipe anchor consisting of telescopic arrangement of 2 sizes of steel tubing separated by minimum 12.7 mm thickness of heavy-duty neoprene and duck, or neoprene isolation material. Provide vertical restraints by similar material arranged to prevent vertical travel in either direction. Design for maximum 3450 kPa load on isolation materials, and provide for equal resistance in any direction. Equip anchor with threaded hole on top and 2 holes in base plate for bolting down; or provide welding provisions top and bottom, if indicated.
- G. Thrust Restraints: Provide horizontal thrust restraints consisting of spring element in series with neoprene pad. Select spring deflection same as for equipment loading.





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Design so thrust restraints can be pre-set and adjusted in field. Attach horizontal restraints at centerline of thrust and symmetrically on either side of unit.

H. Fabricated Equipment Bases: Where supplementary bases are indicated for use with isolator units to support equipment (base not integral with equipment), provide welded rectangular unit, fabricated of structural steel shapes, plates and bars complying with ASTM A36, as shown. Provide welded support brackets at points indicated, and anchor base to spring isolator units. Except as otherwise indicated arrange brackets to result in lowest possible mounting height for equipment, but provide minimum of 25 mm. Provide bolt holes in base matching anchor bolt holes in equipment.

1. Where indicated, provide for auxiliary motor slide base under motor or motor slide rails for adjusting belt tension. Design primary base for bolting of rails or slide base in position.

2. Where sizes of base framing members are not indicated, fabricate base with depth of structure not less than $0.10 \times$ longest span of base, rigidly braced to support equipment without deflections or distortions which would be detrimental to equipment or equipment performance.

I. Inertia Base Frames: Where inertia bases are indicated for use with pad type isolation units to support equipment, provide rectangular structural beam channel, or complete sheet metal box concrete forms for floating foundations, with materials complying with ASTM A36. Frame unit as shown or, if not shown, with minimum depth of $0.08 \times$ longest dimension of base, but not less than 150 mm deep. Size frame as shown or, if not shown, so that weight of frame plus concrete fill will be greater than operating weight of equipment supported. Provide steel reinforcing both ways with both ends of reinforcing butt welded to base framing.

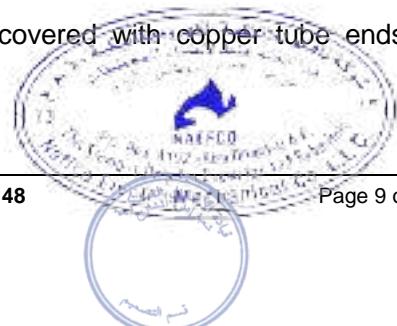
1. Provide anchor bolts, located as required for equipment anchorage and supported for casting of concrete. Locate bolts as indicated.
2. Provide adjustable bolts in pipe sleeves; for minimum of 12.7 mm (1/2") adjustment around anchor bolts.

J. Isolation Hangers: Hanger units formed with brackets and including manufacturer's standard compression isolators of type indicated. Design brackets for 3 times rated loading of units. Fabricate units to accept misalignment of 15 degrees off center in any direction before contacting hanger box, and for use with either rod or strap type members, and including acoustical washers to prevent metal-to-metal contacts.

1. Provide vibration isolation spring with cap in lower part of hanger and rubber hanger element in top, securely retained in unit.
2. Provide hangers, precompressed to rated load to limit deflection during installation. Design so hanger may be released after full load is applied.

K. Flexible Pipe Connectors:

1. For non-ferrous piping, provide bronze hose covered with copper tube ends or bronze flanged ends, braze-welded to hose.

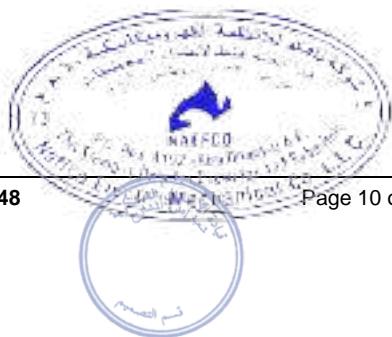


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Section: 21 05 48 (VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION
PIPING AND EQUIPMENT)

-
2. For ferrous piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 1030 kPa ANSI flanges, welded to hose.
 3. Flexible pipe connectors to have screwed ends for pipes 50 mm and under and flanged ends for pipes over 50 mm .
 4. Subject to compliance with requirements, provide flexible pipe connectors of one of the following manufacturers, or approved equal:
 - a. Mason Industries
 - b. Anaconda
 - c. Aeroquip Corp.
 - d. Flexonics
 - e. Keflex, Inc.



**CMW GENERAL SPECIFICATION
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Section: 21 05 48 (VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION
PIPING AND EQUIPMENT)

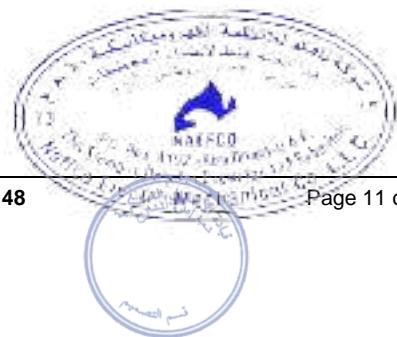
PART 3 EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PERFORMANCE OF ISOLATORS

- A. General: Comply with minimum static deflections recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.
- B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.





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PIPING AND EQUIPMENT)

3.3 APPLICATIONS

- A. General: Except as otherwise indicated, select vibration control products in accordance with latest edition of ASHRAE Handbook, Systems Volume, Chapter 35 "Sound and Vibration Control", Table 27. Where more than one type of product is offered, selection is Contractor's option.
- B. Piping: For piping connected to equipment mounted on vibration control products, install isolation hangers as indicated, and for first 3 points of support for pipe sizes 100 mm and less, for first 4 points of support for pipe sizes 125 mm through 200 mm , and for first 6 points of support for pipe sizes 250 mm and over.
- C. Comply with NFPA 13 & 14 for requirements related to seismic and vibration requirements.

3.4 INSTALLATION

- A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration control materials and units. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.
- B. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.
- C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.
- D. Install inertia base frames on isolator units as indicated, so that minimum of 25 mm clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.
- E. For air handling equipment, install thrust restraints as indicated, and also wherever thrust exceeds 10% of equipment weight.
- F. Locate isolation hangers as near overhead support structure as possible.
- G. Flexible Pipe Connectors: Install on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.
- H. Provide Seismic snubbers on cooling towers, air handling units, pumps, chillers and boilers.
- I. Vibration Isolation:
 1. Connections to Equipment: do not apply any flexible couplings on discharge from fire pumps as per NFPA 20 A.
 2. Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with





Section: 21 05 48 (VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION
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- provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.
3. Provide heat shields where elastomers are subject to temperatures over 38 degrees C (100 degrees F).
 4. Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.
- J. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.

3.5 ADJUSTING AND CLEANING

- A. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated.
- B. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

END OF SECTION 21 05 48





Section21 05 53 (IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

21 05 53

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

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Section21 05 53 (IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Conditions of Contract and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes mechanical identification materials and devices.

1.3 SUBMITTALS

- A. Product Data: For identification materials and devices.
- B. Samples: Of color, lettering style, and graphic representation required for each identification material and device.
- C. Valve Schedules: For each piping system. Reproduce on standard-size bond paper. Tabulate valve number, piping system, system abbreviation as shown on tag, room or space location of valve, and variations for identification. Mark valves intended for emergency shutoff and similar special uses. Besides mounted copies, furnish copies for maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.



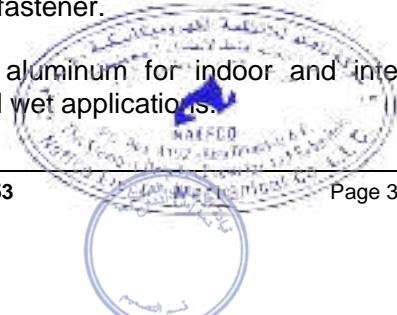


Section21 05 53 (IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

PART 2 PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 21 Sections. If more than one type is specified for application, selection is the Contractor's option, but provide one selection for each product category.
- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped. Nameplates for external and wet applications to be stainless steel.
 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
 2. Location: Accessible and visible.
- C. Stencils: Standard stencils, prepared with letter sizes conforming to recommendations of ASME A13.1. Minimum letter height is 30 mm for ducts, and 20 mm for access door signs and similar operational instructions.
 1. Material: Brass.
 2. Stencil Paint: Exterior, oil-based, alkyd gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.
- D. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl type with permanent adhesive, complying with ASME A13.1.
- E. Pipes, Including Insulation: Full-band pipe markers, extending 360 degrees around pipe at each location.
- F. Lettering: Manufacturer's standard preprinted captions as selected by the Engineer.
 1. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.
- G. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap on, color-coded, complying with ASME A13.1.
- H. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 0.08 mm thick.
 1. Width: 40 mm on pipes with OD, including insulation, less than 150 mm; 65 mm for larger pipes.
 2. Color: Comply with ASME A13.1, unless otherwise indicated.
- I. Valve Tags: Stamped or engraved with 6 mm letters for piping system abbreviation and 13 mm sequenced numbers. Include 4 mm hole for fastener.
 1. Material: 0.8 mm thick, polished brass, or aluminum for indoor and internal applications, and stainless steel for external and wet applications.





Section21 05 53 (IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

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- 2. Size: 40 mm diameter, unless otherwise indicated.
 - J. Valve Tag Fasteners: Brass, wire-link chain; beaded chain; or S-hooks.
 - K. Access Panel Markers: 2 mm thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 3 mm center hole for attachment.
 - L. Valve Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include screws.
 - 1. Frame: Extruded aluminum.
 - 2. Glazing: ASTM C 1036, Type I, Class 1, Glazing quality B, 2.5 mm, single-thickness glass.
 - M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - 1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
 - 2. Thickness: 3 mm, unless otherwise indicated.
 - 3. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
 - N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
 - 1. Green: Cooling equipment and components.
 - 2. Yellow: Heating equipment and components.
 - 3. Brown: Energy reclamation equipment and components.
 - 4. Blue: Equipment and components that do not meet criteria above.
 - 5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
 - 6. Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - O. Size: 65 mm by 100 mm for control devices, dampers, and valves; 115 mm by 150 mm for equipment.
 - P. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
 - 1. Size: 85 mm by 145 mm.
 - 2. Fasteners: Brass grommets and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.





Section21 05 53 (IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

-
- Q. Lettering and Graphics:** Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.
 - R. Multiple Systems:** Identify individual system number and service if multiple systems of same name are indicated.



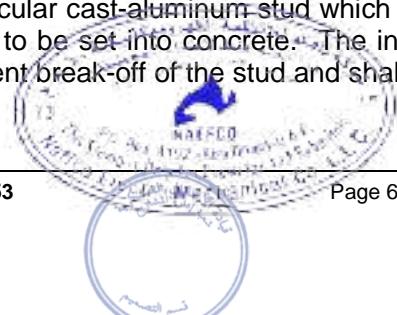


Section21 05 53 (IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

PART 3 EXECUTION

3.1 LABELING AND IDENTIFYING PIPING SYSTEMS

- A. Install pipe markers on each system. Include arrows showing normal direction of flow.
- B. Marker Type: Stenciled markers complying with ASME A13.1.
- C. Fasten markers on pipes and insulated pipes smaller than 150 mm OD by following method:
 1. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 20 mm wide, lapped a minimum of 40 mm at both ends of pipe marker, and covering full circumference of pipe.
- D. Fasten markers on pipes and insulated pipes 150 mm in diameter and larger by following method:
 1. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 40 mm wide, lapped a minimum of 75 mm at both ends of pipe marker, and covering full circumference of pipe.
- E. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, ceilings, and plenums; and exterior nonconcealed locations according to the following:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 3. Near penetrations through walls, floors, ceilings, or nonaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at a maximum of 15 m intervals along each run. Reduce intervals to 7.5 m in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- F. Route Markers for underground services:
 1. Route markers for underground services shall have standardized abbreviations as follows:
 2. FPL - Fire Pipeline
 3. FUEL - Fuel Pipeline
 4. All presently used services shall be classified under the aforesaid categories as deemed relevant. If new services are identified and cannot be logically classified under any of the aforesaid categories, then such services shall be provided with a new, separate abbreviated standard, as approved by the Engineer.
 5. Unless otherwise directed by the Engineer, the abbreviations shall be imprinted clearly in English letters of 12 mm height and 3 mm depth, as per lettering sample shown, on a 100 mm diameter, 10 mm thick circular cast-aluminum stud which has an insert length of at least 100 mm, to allow it to be set into concrete. The insert section shall have a thickness sufficient to prevent break-off of the stud and shall be





Section21 05 53 (IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

- provided with "back-cut" indentations to ensure that the route marker is firmly held in place by the surrounding concrete.
6. The route markers shall be set into the ground surface at finished grade level (FGL) in areas where concrete/tile paving or asphalt is provided. At locations where the FGL finish is bare earth, the route markers shall be embedded onto the top of a concrete pillar which is buried into the earth as detailed below.
 7. The concrete pillars shall be of class P1, filled into 150 mm diameter GRP pipe 600 mm long. The pillars shall be buried into the ground to a depth of 400 mm with the remaining 200 mm projecting above FGL.
 8. The route markers shall be placed along the center line of the underground service route and shall be located at every 75 m along straight runs of the underground service and at every bend on the route. Spacing on curved sections shall be suitably reduced in consultation with the Engineer. Where the underground service is laid in pre-formed raceways that are provided with covers, that cannot accept embedding of the route marker studs, these shall be located at FGL adjacent to the relevant raceway, as approved by the Engineer.
 9. Samples of all the various route markers shall be submitted for approval to the Engineer.
 10. All buried underground services including, fire, pipes etc ... shall be further identified to show service below. The buried pipes shall be covered with plastic sheet identifying type of service. Sheet to extend 300 mm on both sides of pipe and shall be located at 300 mm above identified pipe. Agree with the engineer on colour of plastic sheet and identification letters..

3.2 VALVE TAGS

- A. Install on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.
- B. Valve Tag Application Schedule: Tag valves according to size, shape, color scheme, and with captions similar to those indicated in the following:
- C. Tag Material: Brass or aluminum for indoor and internal applications, and stainless steel for outdoor and wet applications.
- D. Tag Size and Shape: According to the following:
 1. Fire Protection: 40 mm, round.
 2. Sprinkler: 40 mm, round.
 3. Gas: 40 mm, round.
- E. Tag Color: According to the following:
 1. Fire Protection: Red.
 2. Sprinkler: Red.
 3. Gas: Yellow.
- F. Letter Color: According to the following:
 1. Fire Protection: White.
 2. Sprinkler: White.





Section21 05 53 (IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT)

3. Gas: Black.

G. Install mounted valve schedule in each major equipment room.

3.3 EQUIPMENT SIGNS AND MARKERS

A. Install engraved plastic-laminate signs or equipment markers on or near each major item of mechanical equipment. Include signs for the following general categories of equipment:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Fire department hose valves and hose stations.
3. Meters, gages, thermometers, and similar units.
4. Pumps and similar motor-driven units.
5. Tanks and pressure vessels.
6. Strainers, filters and similar equipment.

B. Plasticized Tags: Install within concealed space, to reduce amount of text in exposed sign outside concealment, if equipment to be identified is concealed above acoustical ceiling or similar concealment.

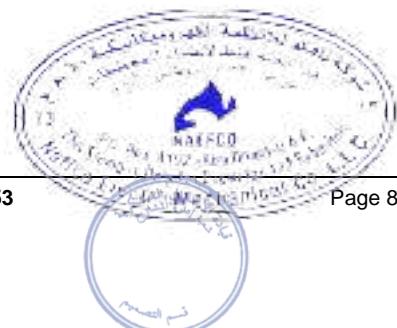
1. Identify operational valves and similar minor equipment items located in unoccupied spaces, including machine rooms, by installing plasticized tags.

3.4 ADJUSTING AND CLEANING

A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.

B. Clean faces of identification devices and glass frames of valve charts.

END OF SECTION 21 05 53



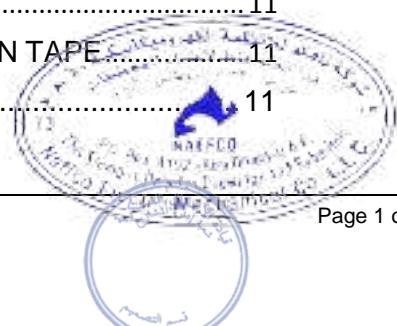


21 12 00

STANDPIPE SYSTEM

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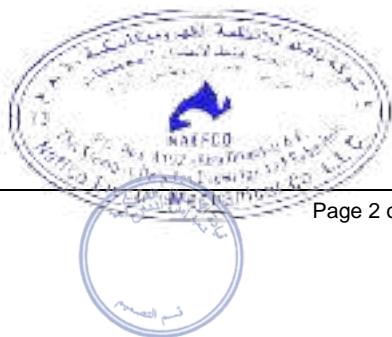


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PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - a. AWWA C651 (2005; Errata 2005) Standard for Disinfecting Water Mains
2. ASTM INTERNATIONAL (ASTM)
 - a. ASTM C1036 (2010e1) Standard Specification for Flat Glass
3. FM GLOBAL (FM)
 - a. FM APP GUIDE Approval Guide
4. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)
 - a. FCCCHR List (continuously updated) List of Approved Backflow Prevention Assemblies
5. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - a. NFPA 13 (2010; Errata 10-1; TIA 10-1; TIA 11-2) Standard for the Installation of Sprinkler Systems
 - b. NFPA 14 (2010) Standard for the Installation of Standpipes and Hose Systems
 - c. NFPA 24 (2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
 - d. NFPA 70 (2011; Errata 2 2012) National Electrical Code
 - e. NFPA 72 (2010; TIA 10-4) National Fire Alarm and Signalling Code
6. UNDERWRITERS LABORATORIES (UL)
 - a. UL Fire Prot Dir (2012) Fire Protection Equipment Directory





7. UAE FIRE & LIFE SAFETY CODE OF PRACTICE

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

a. SD-01 Preconstruction Submittals

1- Hydraulic Calculations:

Submit hydraulic calculations to the Engineer for approval.

b. SD-02 Shop Drawings

Shop Drawings and Manufacturer's Literature: Submit shop drawings and manufacturers literature on fire protection system components, according to the following listing:

1. Hanger Supports
2. Brackets
3. Hangers
4. Clamps
5. List of Manufacturers
6. Piping Layout and Details
7. Valves
8. Pipe
9. Fittings
10. Leak Test Certificates
11. Operation and Maintenance Instructions
12. Mechanical couplings
13. Fire Department Breaching Points
14. Alarm valves
15. Water motor alarms
16. Pressure switch
17. Water flow detector
18. Fire hose cabinets
19. Valve tamper switch
20. Backflow preventer

c. SD-03 Product Data

1. Technical Data

Submit manufacturer's technical product data and installation instructions for fire protection materials and products. Manufacturer's literature and data sheets are to be submitted indicating the necessary installation dimensions, weights, materials and performance information. The performance is to include capacities, pressure drop, design and operating pressure, temperatures, similar data. Complete electrical data, including power conditions, and identifying types and numbers, to be



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included. Where pertinent, electrical diagrams are to be provided. Literature and data sheets may be provided by standard sales sheets marked to indicate the specific equipment provided.

2. Certificate of Installation:

Submit certificate upon completion of fire protection piping work which indicates that work has been tested in accordance with NFPA 13 and NFPA 14, and also that system is operational, complete, and has no defects.

3. Record Drawings:

At project closeout, submit record drawings of installed fire protection piping and products; in accordance with requirements of Division 1.

4. Maintenance Data:

Submit operation and maintenance data and parts lists for fire protection materials and products. Include this data, product data, shop drawings, approval drawings, approval calculations, certificate of installation, and record drawings in maintenance manual; in accordance with requirements of Division 1. Contractor is to furnish data covering model, type and serial numbers, capacities, maintenance and operation of each item of equipment or apparatus. Operating instructions are to cover all phases of control.

5. Valve Schedule:

Furnish a printed schedule, in duplicate, describing each valve by number, giving locations and service for which used. System identification to be as stipulated in the other sections of these specifications. One copy of this schedule is to be mounted under glass in a simple black enamel steel frame and hung in the mechanical equipment room where directed. The other copy is to be submitted to the Engineer before completion of the work.

D. SD-05 Design Data

Design Analysis and Calculations

E. SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with the paragraph entitled, "System Testing," of this section

2. Pressure Tests
3. System Operating Tests
4. Air Tests
5. Valve-Operating Tests
6. Drainage Tests

Data which describes more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Submit one original for each item and clear, legible, first-generation





photocopies for the remainder of the specified copies. Incomplete or illegible photocopies will not be accepted. Partial submittals will not be accepted.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications of Installer

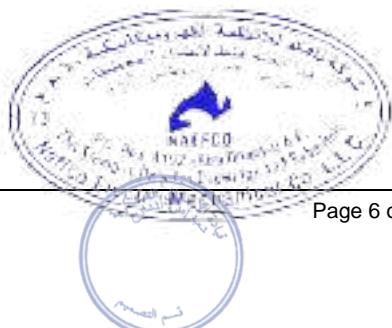
Prior to commencing work, submit data showing that the specialized sub-Contractor has successfully installed fire extinguishing standpipe systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having the required experience. Include the names and locations of at least five installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system, and certify that the system has performed satisfactorily for a period of at least 18 months. Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings shall be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by UAE Civil Defence. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

1.3.2 System As-Built Drawings

Upon completion, and before final acceptance of the work, submit a complete set of as-built drawings of each system. Furnish as-built (record) working drawings in addition to the as-built drawings required by Division 1, "General Requirements."

1.4 DELIVERY, STORAGE AND HANDLING

Protect stored equipment from weather, humidity and temperature variations, dirt, dust, and other contaminants





PART 2 PRODUCTS

2.1 ABOVEGROUND PIPING SYSTEMS

Provide fittings for changes in direction of piping and for connections.

Make changes in piping sizes through tapered reducing pipe fittings; bushings will not be permitted. Perform welding in the shop; field welding will not be permitted. [Conceal piping in areas with suspended ceiling.]

2.1.1 Pipe and Fittings

NFPA 14, except as modified herein. Steel piping shall be Schedule 40 for sizes less than 200 mm 8 inches, and Schedule 30 or 40 for sizes 200 mm 8 inches and larger. Fittings shall be welded, threaded, or grooved-end type. Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into the pipe when pressure is applied will not be permitted. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 40 mm 1.5 inches and larger. Fittings shall be UL Fire Prot Dir listed or FM APP GUIDE approved for use in dry /wet pipe sprinkler systems. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer. Steel piping with wall thickness less than Schedule 30 shall not be threaded.[Side outlet tees using rubber gasketed fittings shall not be permitted. Pipe and fittings shall be metal.

2.1.2 Pipe Hangers and Supports

Provide in accordance with NFPA 14.

2.1.3 Valves

NFPA 14. Provide valves of types approved for fire service. Hose and gate valves shall open by counterclockwise rotation. Provide isolation and check valves as required by NFPA 14. Isolation valves shall be OS&Y type. Check valves shall be flanged clear opening swing-check type with flanged inspection and access cover plate for sizes 100 mm 4 inches and larger.

2.1.3.1 Hose Valves

Provide bronze [pressure regulating type] hose valve with 65 mm National Standard male hose threads, and 65 mm NH female by 40 mm IPT male reducer with cap and chain.

2.1.4 Identification Signs

NFPA 14. Attach properly lettered and approved metal signs to each valve and alarm device.

2.1.5 Water flow Test Connection

Provide test connections approximately 1.83 m above the floor for each standpipe system or portion of each standpipe system equipped with an alarm device; locate downstream and adjacent to each alarm actuating device. Provide test connection piping to a location where the discharge will be readily



visible and where water may be discharged without property damage. Discharge to janitor sinks or similar fixtures shall not be permitted. Provide discharge orifice equivalent to 15 mm sprinkler orifice.

2.1.6 Main Drains

Provide separate drain piping to discharge at safe points outside each building or to sight cones attached to drains of adequate size to readily receive the full flow from each drain under maximum pressure. Provide auxiliary drains as required by NFPA 13 and NFPA 14.

2.1.7 Pipe Sleeves

Provide where piping passes entirely through walls, floors, roofs and partitions. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs and partitions. Provide one inch minimum clearance between exterior of piping and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of

the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with UL listed fill, void, or cavity material .

2.1.7.1 Sleeves in Masonry and Concrete Walls, Floors, and Roofs

Provide hot-dip galvanized steel, ductile-iron, or cast-iron sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth. Extend sleeves in floor slabs 76 mm above finished floors.

2.1.7.2 Sleeves in Partitions

Provide 26 gage galvanized steel sheet.

2.1.8 Escutcheon Plates

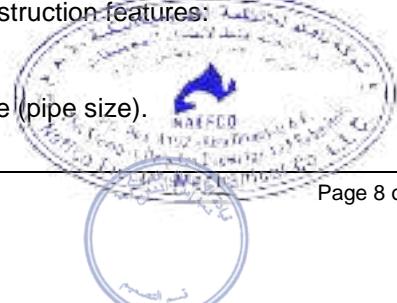
Provide one piece or split hinge type metal plates for piping passing through walls, floors, and ceilings in both exposed and concealed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces. Securely anchor plates in place.

2.1.9 Fire Department Connections

Provide Wall Type Siamese Connections: Provide where indicated, wall type cast brass flush Siamese connections and escutcheon plate assembly, with two, 65 mm fire department inlets with female hose connections, fire hose connection screw thread adapted to locally used hoses, equipped with individual drop clapper valves, equipped with plugs and chains, construction features as indicated, and constructed with the following additional construction features:

Finish: Chrome plate.

Inlet Pipe: 100 mm pipe, 125 mm pipe, or 150 mm pipe (pipe size).





Cast Lettering: "AUTO. SPKR."/"STAND PIPE". English and Arabic

Escutcheon: 180 mm x 360 mm rectangular.

2.1.10 Alarm Valves

Provide variable pressure type alarm valve complete with retarding chamber, alarm test valve, alarm shutoff valve, drain valve, pressure gages, accessories, and appurtenances for the proper operation of the system. The alarm shut-off valve in the piping between the alarm valve and the alarm pressure switch shall be a UL listed electrically supervised quarter-turn valve. Connection of switch shall be under Section [28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM.] [28 31 63.00 20 ANALOG/ADDRESSABLE INTERIOR FIRE ALARM SYSTEM.]

2.1.11 Water Motor Alarms

Provide alarms of the approved weather proof and guarded type, to sound locally on the flow of water in each corresponding standpipe. Mount alarms on the outside of the outer walls of each building. Provide separate drain piping directly to exterior of building.

2.1.12 Pressure Switch

Provide switch with circuit opener or closer [SPDT contacts] for the automatic transmittal of an alarm over the facility fire alarm system. Connect into the building fire alarm system. Alarm actuating device shall have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and shall instantly recycle.

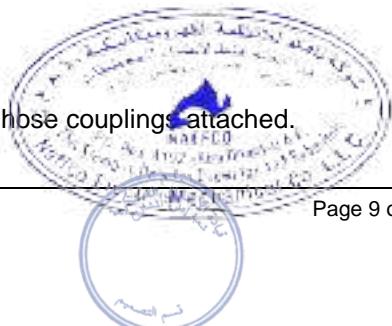
2.1.13 Waterflow Detector

Provide vane-type waterflow detector. Provide detector with adjustable retard feature to prevent false alarms caused by momentary water surges. Connect into the building fire alarm system. [Alarm actuating device shall have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and shall instantly recycle.] Provide detector in accordance with manufacturer's instructions.

2.1.14 Fire Hose Cabinets

A. Recessed type, with stainless steel body and trim and door. Body and trim to be 16 gauge and door 20 gauge thickness. Door to have full panel double strength glass (or solid as indicated or approved at site) with "Fire Hose" decal. Hose rack cabinet to be supplied from factory with the following equipment:

1. one 65 mm pressure restricting angle valve,
2. one 65 mm x 40 mm chrome finished brass reducer,
3. one stainless steel hose rack with rack nipple,
4. one 40 mm unlined linen fire hose 30 m long, with brass hose couplings attached.





Section: 21 12 00 (STANDPIPE SYSTEM)

5. one 40 mm brass nozzle, 250 mm long, 15 mm discharge, with chrome finish,
 6. one 4.5 kg ABC nitrogen operated dry chemical fire extinguisher, with steel body and stainless steel finish.
- B. Surface mounted type, with clear anodized, 16 gauge thick stainless steel body, trim and door. Door to have full panel double strength glass (or solid as indicated or approved at site) with "Fire Hose" decal. Hose rack cabinet to be supplied from factory with the following equipment:
1. one 65 mm pressure restricting angle valve,
 2. one 65 mm x 40 mm chrome finished brass reducer,
 3. one stainless steel hose rack with rack nipple,
 4. one 40 mm unlined linen fire hose 30 m long, with brass hose couplings attached.
 5. one 40 mm brass nozzle, 250 mm long, 15 mm discharge, with chrome finish,
 6. one 4.5 kg ABC nitrogen operated dry chemical fire extinguisher, with stainless steel body .
- C. Construction: Manufacturer's standard enameled steel box, with trim, frame, door and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames. Provide pipe knockouts.

2.1.15 Valve Tamper Switch

Provide valve tamper switch(es) to monitor the open position of valve(s) controlling water supply to the standpipe system. Switch contacts shall transfer from the normal (valve open) position to the off-normal (valve closed) position during the first two revolutions of the hand wheel or when the stem of the valve has moved not more than one-fifth of the distance from its normal position. Switch shall be tamper resistant. Removal of the cover shall cause switch to operate into the off-normal position.

2.1.16 Fire Pumps

Provide as specified in Section 21 30 00 FIRE PUMPS.

2.1.17 Backflow Preventer

Provide [reduced pressure principle] or [double check] valve assembly backflow preventer with OS&Y gate valve on both ends. Each check valve shall have a drain. Backflow prevention assemblies shall have current "Certificate of Approval" from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List. Listing of the specific make, model, design, and size in the FCCCHR List shall be acceptable as the required documentation."

2.2 BURIED PIPING SYSTEMS





Section: 21 12 00 (STANDPIPE SYSTEM)

2.2.1 Buried Pipe and Fittings

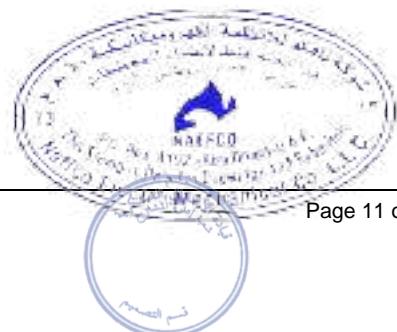
NFPA 24, outside coated, cement lined, ductile iron pipe and fittings or HDPE or as indicated on plans for piping under the building and to a point 1.52 m outside the building walls. Anchor the joints in accordance with NFPA 24 using pipe clamps and steel rods. Minimum pipe size shall be 150 mm . Minimum depth of cover shall be one meter. Piping more than 1.52 m outside the building walls shall be provided under Section 33 11 00 WATER DISTRIBUTION.

2.2.2 Buried Utility Warning and Identification Tape

Provide detectable tape in accordance with Section 31 00 00 EARTHWORK

2.3 ELECTRICAL WORK

Provide electrical work associated with this section under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for fire alarm wiring. Provide fire alarm wiring and connection to fire alarm systems under Section [28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM], [28 31 63.00 20 ANALOG/ADDRESSABLE INTERIOR FIRE ALARM SYSTEM.],[this section in accordance with NFPA 70 and NFPA 72]





PART 3 EXECUTION

3.1 EXCAVATION, BACKFILLING, AND COMPACTING

Provide under this section as specified in Section 31 00 00 EARTHWORK.

3.2 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

Connections to existing water supply system are specified in Section 33 11 00 WATER DISTRIBUTION.

3.3 STANDPIPE SYSTEM INSTALLATION

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the NFPA standards referenced herein. Install piping straight and true to bear evenly on hangers and supports. [Conceal piping to the maximum extent possible. Piping shall be inspected, tested and approved before being concealed.] Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; do not use bushings. Cut pipe accurately and work into place without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Clean with solvent to remove all varnish and cutting oil prior to assemble. Make screw joints with PTFE tape applied to male thread only.

3.4 DISINFECTION

Disinfect new water piping from the point of connection at the water main and existing water piping affected by the Contractor's operation in accordance with AWWA C651. Exercise caution when mixing chlorine disinfectant solutions. Fill piping systems with solution containing minimum of 50 parts per million of free available chlorine and allow solution to stand for a minimum of 24 hours. Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit results prior to new water piping being placed into service.

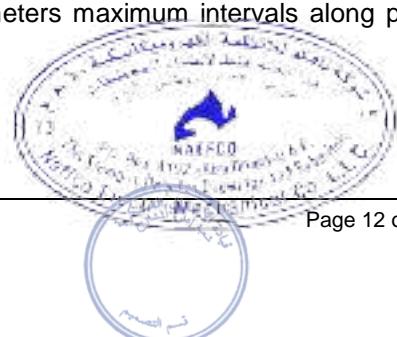
3.5 FIELD PAINTING

Field painting of fire extinguishing standpipe system shall be specified in Section 09 90 00 PAINTS AND COATINGS. Field painting requirements for "Fire Extinguishing Sprinkler Systems" shall apply.

3.5.1 Piping Labels

Provide permanent labels in mechanical rooms, spaced at 6 meters maximum intervals along pipe, indicating "STANDPIPE".

"





3.6 3.6 ELECTRICAL WORK

Provide electrical work associated with this section under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for fire alarm wiring. Provide fire alarm wiring and connection to fire alarm systems under Section [28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM], [28 31 63.00 20ANALOG/ADDRESSABLE INTERIOR ALARM SYSTEM.], [this section in accordance with NFPA 70 and NFPA 72].

3.7 3.7 FLUSHING

Flush the piping system with potable water in accordance with NFPA 14. Continue flushing operation until water is clear, but for not less than 10 minutes.

3.8 3.8 FIELD QUALITY CONTROL

Prior to initial operation, inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals. Perform tests in the presence of CMW Engineer to determine conformance with the specified requirements.

3.8.1 Preliminary Tests

Each piping system shall be hydrostatically tested in accordance with NFPA 14 and NFPA 24 and shall show no leakage or reduction in gauge pressure after 2 hours. The Contractor shall conduct complete preliminary tests, which shall encompass all aspects of system operation. [Individually test alarms, and all other components and accessories to demonstrate proper functioning. Test water flow alarms by flowing water.] When tests have been completed and all necessary corrections made, submit to CMW Engineer a signed and dated certificate, similar to that specified in NFPA 13, attesting to the satisfactory completion of all testing and stating that the system is in operating condition. Also include a written request for a formal inspection and test.

3.8.2 Formal Inspection and Tests (Acceptance Tests)

CMW Engineer and / or committee, Fire Protection Engineer, (Civil Defence or Military fire brigade) will witness formal tests and approve all systems before they are accepted. The system shall be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of CMW Engineer and written certification to this effect is received by the Fire Protection Engineer. Submit the request for formal inspection at least 15 working days prior to the date the inspection is to take place. Experienced technicians regularly employed by the Contractor in the installation of both the mechanical and electrical portions of such systems shall be present during the inspection and shall conduct the testing. All instruments, personnel, appliances and equipment for testing shall be furnished by the Contractor is responsible to provide test water in case instructed by CMW All necessary tests encompassing all aspects of system operation shall be made including the following, and any deficiency found shall be corrected and the system retested at no cost to the Government.

3.8.2.1 Flow Test

Perform flow tests of each standpipe riser in accordance with NFPA 14. Affix [0-200] [0-300] psi pressure gauges to lowest hose valve and next-to-highest hose valve. Connect line 1, 65 mm diameter fire hose with underwriter's playpipe to highest hose valve and flow at least 946 L/m³ (250 gpm) for 5



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minutes from standpipe to a safe location outside the building. [For dry pipe system, supply system through 65 mm fire hose connected to the nearest fire hydrant which is Furnish hose, nozzles and fittings required for this test.

3.8.2.2 Alarm Testing

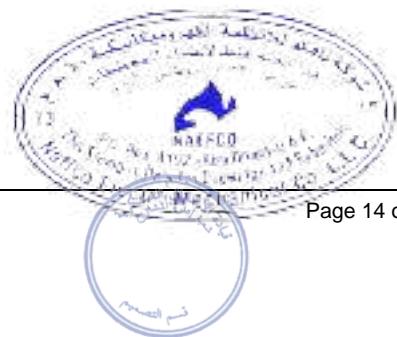
- a. Each pressure switch, waterflow detector, and water motor gong shall be activated by flow of water.
- b. Each valve tamper switch shall be activated by partially closing the associated control valve.
- c. Alarm annunciation at the fire alarm control panel shall be verified.
- d. Circuit supervision shall be demonstrated.

3.8.3 Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the CMW Engineer shall be notified when the additional work has been completed, to arrange a new inspection and test of the system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

-- End of Section --

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SCOPE OF WORK

1	The Subcontractor's scope is to Design, Supply, Install, Test & Commission and Handing Over for complete FLS Systems including to follows but not limited :
1.1	Fire Fighting Systems includes :
	A- FIRE PUMP SET
	B- Sprinkler System Includes Sprinklers , ZCV , OS&Y valve , Supervisory switch and related accessories
	C- Water Spray System includes Deluge Valve , Butterfly Valve & Spray Nozzle
	D- Firefighting System includes FHC , Breeching Inlet, Fire Extinguisher and related accessories
	E- FIRE SUPPRESSION, Foam System & Clean Agent SYSTEMS
	F- Tanks Puddle Flange and Vortex plates
	G- FIRE HYDRANT SYSTEM
	H- FF pipes (GI & HDPE) includes related support and hanger system
	I-Seismic Study and Support to all FLS services and equipments
	J- Fire Sealant to related FLS Services
1.2	Fire Alarm System including panels , Detectors , Modules , cable, containment & Accessories in tunnels and TSB's
1.3	Linear Heat Detection System inside the tunnels includes panel , cable , mounting hock & integration
1.4	Emergency light and Illuminated signage system with central monitoring includes Cable , Battary , Panels , Emergency light , Signage system and related containments and cabling including power and monitor cable
1.5	Smoke Management system includes Fans , Fire rated Duct , MSFD , SMS panels and related accessories and Connection and interfaces with FLS system
1.6	CFD analysis for SMS , Fire Suppression system and Tunnel Ventilation based of HRR
1.7	Required Power supply units supply and installation , cabling and distribution.
2	The Subcontractor to creat complete systems workable shop drawings as per project's specifications, design and in accordance with authority requirements for CMW Engineer / Client's review and approval
3	Technical Material Submittal preparation and approval from all concerned parties
4	method statement preparation for installation, Testing & commissioning
5	Third-Party approval of Shop Drawings if required
6	All Civil Defense submissions and Fees
7	The Subcontractor is fully responsible to get the authority approval without additional cost or time impact, Furthermore, NOC from relevant authorities if required.
8	After completion of installation, the subcontractor shall carry out the Testing, Programming, Commissioning, Integration with other Systems and Handover the complete Operating System subject to the Approval of the CMW Engineer and Facility management and Civil Defense .
9	Operator's Training and Handing-Over
10	As-Built Drawings
11	Third-Party Certifications if required
12	Spare Parts to be part of S/c scope of works
13	Warranty Certificates as per the Project Specifications and Control Condition.
14	Operation & Maintenance Manuals as per the Project specifications and Contract Condition
15	Liability Period as per Project's specs. And contract Conditions.
16	Factory witness if required
17	Loading ,off-loading and shifting of the material to the store and from store to Installation location to be the FLS Subcontractor
18	Schafolidding , Plant and equipments for the installtion to be the FLS Subcontractor
19	site facilities , rest area and Storage containers by sub-contractor , space will be arranged by Royal advance



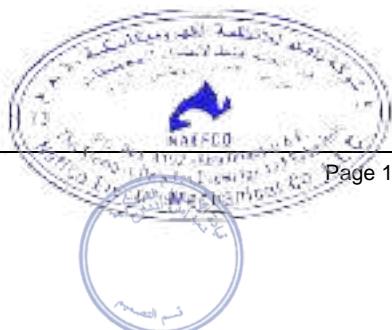


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HVAC POWER VENTILATORS

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Section: 23 34 23 (HVAC POWER VENTILATORS)

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.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. Perform all Work required to provide and install the following fans indicated by the Contract Documents with supplementary items necessary for proper installation.
 1. Centrifugal roof, up-blast, and sidewall exhauster.
 2. Centrifugal roof supply fan.
 3. Make-up air unit.
 4. Centrifugal up-blast grease hood exhaust fan.
 5. Tube axial up-blast smoke control exhaust fan.
 6. Motors and drives.

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 1. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 2. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
 3. AMCA 99 - Standards Handbook.
 4. ACMA 203 - Fan Application Manual - Field Performance Measurements.
 5. AMCA 204 - Balance Quality and Vibration Levels For Fans
 6. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 7. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
 8. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 9. NEMA MG1 - Motors and Generators.
 10. NFPA 70 - National Electrical Code.
 11. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
 12. UL 705 – Power Ventilators.

1.4 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal. The sound power levels must not exceed those indicated on Drawings.



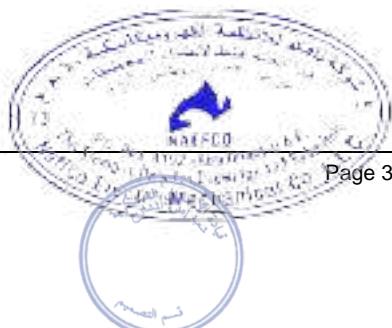
- C. Fabrication: Conform to AMCA 99.
- D. Performance Base: 50 feet above sea level.
- E. Fans shall be capable of operating stably at reduced loads imposed by means of variable speed drives, inlet guide vanes or controlling pitch of fan blades.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Submittal data for approval for all fans of every description furnished under this section of these Specifications.
 - 2. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, gages and finishes of materials, special coatings and construction, electrical characteristics and connection requirements.
 - 3. Fan curves with specified operating point clearly plotted. The recommended range of operation shall be stable.
 - 4. Data on sound power levels for both fan inlet and outlet at rated capacity.
 - 5. All data on fan accessories.
- B. Operation and Maintenance Data:
 - 1. Manufacturer's installation instructions and operating and maintenance data.
 - a. Submit under provisions of Division 01.
 - b. Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to the Project Site under provisions of Division 01 and Division 2.
- B. Accept products on Site in factory-fabricated protective containers or coverings, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- D. Check and maintain equipment on a monthly basis to ensure equipment is being stored in accordance with manufacturer's recommended practices. Additionally, during each check, fans and motors shall be rotated and greased and shafts shall be left approximately 180 degrees from that of previous month. Maintain storage records that indicate these maintenance requirements have been met.





PART 2 PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Fans shall be either belt or direct drive as scheduled on Drawings.
- C. Select fans such that they do not increase motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Provide fans capable of accommodating static pressure variations of plus or minus 10 percent.
- D. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.

2.2 CENTRIFUGAL ROOF, UPBLAST, AND SIDEWALL EXHAUSTER

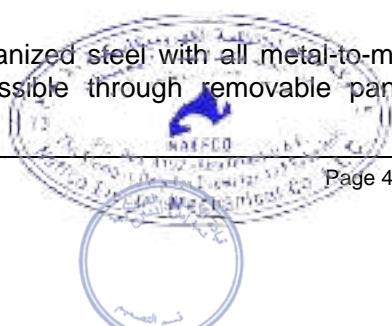
- A. Backward inclined fan wheel with spun aluminum housing; resilient mounted motor and drive assembly; 16 gage aluminum birdscreen; square base to suit roof curb with continuous curb gaskets; secured to roof curb with cadmium plated or stainless steel bolts and screws.
- B. Roof Curb: Roof curb shall be coordinated with CMW and Contractor.
- C. Backdraft Damper: Gravity activated or motorized as indicated. Where type is not indicated on Drawings or Specifications, provide gravity-activated damper. Aluminum construction, felt edged with nylon bearings.
- D. Upblast exhausters shall have integral drain trough.
- E. Apply three coats of air-dried Heresite coating by fan manufacturer both internal and external to all roof exhausters for corrosive applications.

2.3 CENTRIFUGAL ROOF SUPPLY FAN

- A. Forward curved, double width double inlet, with heavy gage galvanized steel housing; resiliently mounted motor and drive assembly.
- B. Backdraft Damper: Gravity activated or motorized as indicated. Where type is not indicated on Drawings or Specifications, provide gravity-activated damper. Aluminum construction, felt edged with nylon bearings.
- C. Roof Curb: Roof Curb shall be coordinated with CMW and Contractor.
- D. Filters: 1-inch washable, aluminum, permanent type as furnished with unit.
- E. Hood shall be easily removable for service.

2.4 MAKE-UP AIR UNIT

- A. Unit: Internal frame type construction of G90 galvanized steel with all metal-to-metal surfaces sealed. All components shall be accessible through removable panels.





Provide unit on prefabricated roof curb. Installed unit shall be in total compliance with NFPA 96.

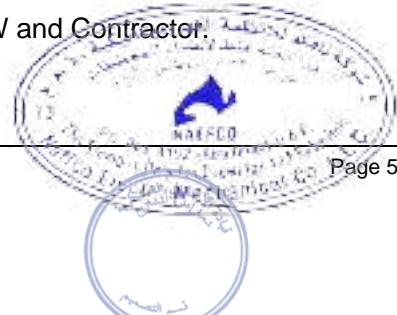
- B. Where scheduled chilled water or direct expansion (DX) coils shall be installed in unit. Water and steam coils shall be rated in accordance with ARI 410. Electric coils shall be UL listed with integral heater control cabinet and a separate power connection for the coils. Downstream components of tempered units shall be double wall construction and insulated in accordance with local energy codes.
- C. Fan Section: Forward curved, double width double inlet, with heavy gage galvanized steel housing; resiliently mounted motor and drive assembly.
- D. Weather Hood: Construct of G90 galvanized steel with 1-inch washable, aluminum, permanent type as furnished with unit at unit intake. Extended weatherhood shall be provided where necessary to ensure minimum ten (10) foot separation between air intake and exhaust air. Weather hood extensions shall be mounted on adjustable legs.
- E. Electrical: All electrical components shall be factory wired for a single point power connection. Control center shall include motor starter, control circuit fusing, control transformer (120VAC), integral door interlocking disconnect switch with separate motor fusing and terminal strip with overload protected motor.
- F. Backdraft Damper: Gravity activated or motorized as indicated. Where type is not indicated on Drawings or Specifications, provide gravity-activated damper.

2.5 CENTRIFUGAL UPBLAST GREASE HOOD EXHAUST FAN

- A. Backward inclined fan wheel, upblast roof fan with spun aluminum housing; resilient mounted motor and drive assembly; square base to suit roof curb with continuous curb gaskets; secured to roof curb with cadmium plated or stainless steel bolts and screws. External fan wiring.
- B. Roof Curb: Roof curb shall be coordinated with CMW and Contractor. Vented roof extension, to maintain fan discharge a minimum of 40-inches above roof, shall be provided by fan manufacturer.
- C. Integral drain trough, cleanout port, and grease trap.
- D. Maximum continuous operating temperature of 400 degrees F.
- E. UL 762 Listed and constructed in compliance with NFPA 96.

2.6 TUBE AXIAL UP-BLAST SMOKE CONTROL EXHAUST FAN

- A. Propeller shall be fabricated steel. Provide with statically and dynamically balanced steel blades and hubs, securely attached to the fan shafts, ground and polish steel fan shafts, galvanized formed channel steel drive frame assembly, deep formed inlet venture fan panels, heavy gage galvanized steel windbands with reinforced edges and bolted seams, square base to suit roof curb gaskets; secured with stainless steel bolts and screws.
- B. Roof curb: Roof curb shall be coordinated with CMW and Contractor.





- C. Butterfly Dampers: Steel or aluminum construction based on the required minimum fan speed required to open damper blades. Provide with magnetic damper latches.
- D. Fan shall meet requirements and be listed for AMCA Certified Rating Seal for sound and air performance and UL Listed Power Ventilators for Smoke Control Systems to include the IRI requirements for 500 degrees F for a minimum of 4 hours, SBCCI Standard Fire Prevention Code for requirements of 1000 degrees F for a minimum of 15 minutes.

2.7 AIR CURTAIN UNIT

- A. Rigid welded construction for support at each end without need for intermediate support. Air curtain fans shall be provided with a weatherproof housing constructed of minimum 16-gage rigid welded steel with baked enamel finish by fan manufacturer.
- B. Fan wheels shall be forward curved, non-overloading, centrifugal type, double inlet, double width with brazed hubs, statically and dynamically balanced. Wheels and housings shall be galvanized steel.
- C. Each curtain shall be furnished with a door switch to energize curtain whenever the door is open, and actuate the hot water control valve to maintain the temperature set point. Units shall be provided with factory mounted, factory wired control panels including motor starters, transformer for low voltage door switch and terminal strip for connection to power source. Provide a discharge grille and conduit box for single point connection for fan and controls.
- D. Air curtains shall attain air velocities specified within 2 seconds following activation. Air intake and discharge openings shall be protected by bird screens. Air curtain shall be at least as wide as the opening to be protected. Air discharge opening shall be so designed and equipped as to permit outward adjustment of the discharge air. Installation and adjustment shall be in accordance with the manufacturer's written instructions. Interior surfaces of the air curtain shall be accessible for cleaning.
- E. Fan noise levels shall not exceed 45 dBA when measured at a distance of ten (10) feet from fan discharge opening.
- F. Air curtains designed for use in service entranceways shall develop an air curtain not less than three (3) inches thick at the discharge nozzle. The air velocity shall not be less than 1600 fpm across the entire entryway when measured 3 feet above the floor.
- G. Where scheduled, include hot water coils with copper tubes and copper fins. Coil shall be rated at 230 psig and 300 degrees F with capacities per ARI 410. Provide UL approved, factory-mounted and factory-wired electric coils where scheduled.
- H. Provide control panel with motor starter, terminal strip, motor overloads, and control transformer. Provide field adjustable time delay relay, ON-OFF-AUTOMATIC switch.

2.8 MOTORS AND DRIVES (ALL UNITS UNLESS OTHERWISE SPECIFIED)

- A. Motors: In total compliance with motors and controllers Specification sections.
- B. Disconnect Switches: Provide for each fan under Division 26. No switches shall be provided in fan housing. All disconnects shall be external to fan housing.
- C. Bearings: L-10 life at 200,000 hours self-aligning, ball or roller bearings.



CMW GENERAL SPECIFICATION
DIVISION 23



Section: 23 34 23 (HVAC POWER VENTILATORS)

- D. Shafts: Hot rolled steel, ground and polished, with key-way, protectively coated with lubricating oil. Provide 316 stainless steel shafts for corrosive applications.
- E. Belt Drive: All belt drives shall be designed for a minimum of 50 percent overload. Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 horsepower and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 20 horsepower and over. Where more than one belt is required, matched sets shall be used. Include an additional set of drives for each fan to be used for final adjustments. After correct speed has been determined with variable sheave, provide fixed sheaves.





Section: 23 34 23 (HVAC POWER VENTILATORS)

PART 3 EXECUTION

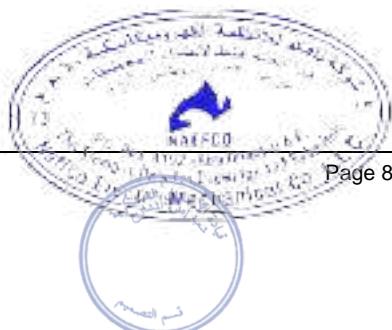
3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Roof Curbs: Roof curb installation shall be coordinated with CMW and Contractor.
- D. Disconnect Switches: Disconnect switches shall be installed adjacent to fan on unistrut per Division 26. Coordinate installation with CMW.

3.2 PAINTING

- A. Provide equipment with factory finish in accordance with the manufacturer's standards. Touch up scratches and marks from handling and installation with masking enamel to match manufacturer's color.
- B. Where exhaust fans are required to have Heresite coating, have units factory finished with required number of coats prior to shipping to the Project Site.
- C. Refer to Division 09 for Site-applied finishes.

- End of Section -



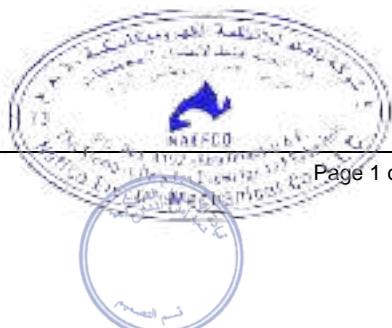


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DUCTWORK

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PART 1 GENERAL

1.1 RELATED DOCUMENTS

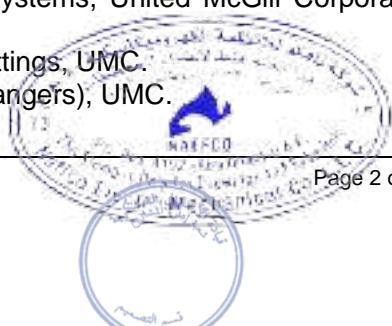
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. Provide materials and installation for complete first class HVAC systems; install ductwork, flexible duct, hangers, supports, sleeves, flashings, vent flues, and all necessary accessories as indicated in the Contract Documents. Provide any supplementary items necessary for proper installation that make the systems operable, code compliant and acceptable to the authorities having jurisdiction.

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 1. ASHRAE - Handbook of Fundamentals; Duct Design.
 2. ASHRAE - Handbook of HVAC Systems and Equipment; Duct Construction.
 3. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
 4. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
 5. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 6. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 7. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
 8. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.
 9. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
 10. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
 11. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooling Equipment.
 12. NFPA 45 – Laboratory Ventilating Systems and Hood Requirements.
 13. SMACNA – HVAC Duct Construction Standards.
 14. SMACNA – Rectangular Industrial Duct Construction Standards.
 15. SMACNA – Round Industrial Duct Construction Standards.
 16. SMACNA – HVAC Air Duct Leakage Test Manual.
 17. UL 181 - Factory-Made Air Ducts and Connectors.
 18. Engineering Design Manual for Air Handling Systems, United McGill Corporation (UMC).
 19. Assembly and Installation of Spiral Ducts and Fittings, UMC.
 20. Engineering Report No. 132 (Spacing of Duct Hangers), UMC.





21. AWS D1.1 American Welding Society Structural Welding Code.

1.4 INSTALLER QUALIFICATIONS:

- A. Company shall have minimum three years documented experience specializing in performing the work of this section.
- B. Installation of HVAC systems shall be performed by qualified Journeyman.

1.5 DEFINITIONS

A. Low Pressure

1. 2 inch W.G. Pressure Class: Ductwork systems up to 2 inch w.g. positive or negative static pressure with velocities less than or equal to 1500 fpm.

B. Medium Pressure

1. 3 inch W.G. Pressure Class: Ductwork systems over 2 inch w.g. and up to 3 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.
2. 4 inch W.G. Pressure Class: Ductwork systems over 3 inch w.g. and up to 4 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.
3. 6 inch W.G. Pressure Class: Ductwork systems over 4 inch w.g. and up to 6 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.

C. High Pressure

1. 10 inch W.G. Pressure Class: Ductwork systems over 6 inch w.g. and up to 10 inch w.g. positive or negative static pressure with velocities greater than 2500 fpm.

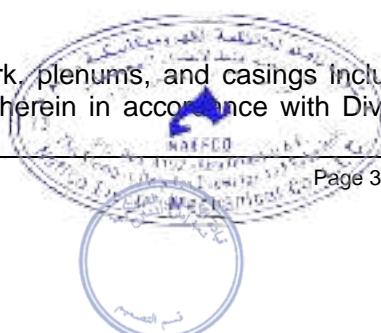
1.6 SUBMITTALS

A. Product Data:

1. Provide the following information for each sheet metal system furnished on the Project:
 - a. System name and type.
 - b. Duct system design pressure.
 - c. Duct material.
 - d. Duct gage.
 - e. Transverse joint methods.
 - f. Longitudinal seam type.
 - g. Sealant type.
 - h. SMACNA rectangular reinforcement type.
 - i. SMACNA intermediate reinforcement type.
 - j. SMACNA transverse reinforcement type.

B. Record Documents:

1. Submit Shop Drawings on all items of ductwork, plenums, and casings including construction details and accessories specified herein in accordance with Division





01. Ductwork construction details and materials used for duct sealant, flexible connections, etc. shall be submitted and approved prior to the fabrication of any ductwork.
2. [Option if no Shop Drawings are required: Prepare Shop Drawings for the purpose of coordination with other trades including structural, piping, plumbing, electrical, lighting, and architectural. When Shop Drawings are not required to be submitted for the Project, field sketches and shop tickets must be available to CMW upon request. Changes required during construction to accommodate coordination issues will be performed at no additional cost to CMW].
3. Draw ductwork Shop Drawings on minimum 1/4 inch equal to one foot scale building floor plans and shall indicate duct sizes, material, insulation type, locations of transverse joints, fittings, ductwork bottom elevation, offsets, ductwork specialties, fire and fire/smoke dampers, and other information required for coordination with other trades. Clearly designate fire and fire/smoke partitions on the Shop Drawings. Detail Drawings for mechanical rooms and air handling unit locations shall be submitted at a minimum scale of 1/4 inch equal to one foot.
4. Coordinate with all other trades and building construction prior to submitting Shop Drawings for review. Indicate location of all supply, return, exhaust, and light fixtures from approved reflected ceiling plans on Shop Drawings.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the Project Site and store and protect products under provisions of Division 01 and Division 20.
- B. Protect materials from rust both before and after installation.

1.8 WARRANTY

- A. All ductwork shown on the Drawings, specified or required for the air conditioning and ventilating systems shall be constructed and erected in a first class workmanlike manner.
- B. The Work shall be guaranteed for a period of one (1) year from the Project Substantial Completion date against noise, chatter, whistling, vibration, and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall be corrected as directed by CMW at Contractor's expense.





PART 2 PRODUCTS

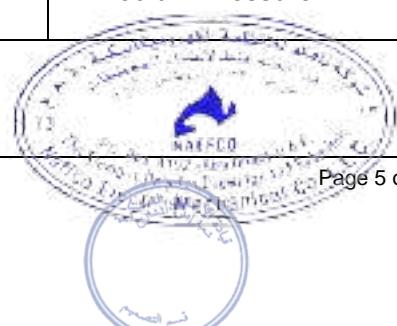
2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 APPLICATION

- A. Ductwork systems shall be constructed in accordance with the following Materials as a minimum standard. Refer to Drawings for any deviation from this Table.

AIR SYSTEM	MATERIAL	MINIMUM PRESSURE CLASSIFICATION ⁽¹⁾
Supply and Return Systems:		
Untreated Outside Air Intake (Louver) to AHU Plenum	304 Stainless Steel	Low Pressure
Treated Outside Air to AHU	Galvanized Steel	Medium Pressure
Single Zone FCU Supply	Galvanized Steel	Low Pressure
Single Zone AHU Supply	Galvanized Steel	Medium Pressure
Mixed Air (AHU Plenum)	Galvanized Steel	Medium Pressure
AHU Discharge/Vertical Supply Riser	Galvanized Steel	Medium Pressure
Vertical Supply Riser to Terminal Unit	Galvanized Steel	Medium Pressure
Terminal Unit Connection	Metal Flexible Duct	As Specified
Terminal Units to Supply Air Device	Galvanized Steel ⁽²⁾	Low Pressure
Vivarium Supply Air Valve to Air Device	316L Stainless Steel (5)	Low Pressure
Return Air Device to Return Distribution	Galvanized Steel ⁽²⁾	Low Pressure
Return Air Distribution	Galvanized Steel	Medium Pressure
Return Air Distribution/Vertical Riser	Galvanized Steel	Medium Pressure
Ductwork in MRI Rooms	Aluminum	As Specified
Exhaust Systems:		
Exhaust Air Device to Exhaust Distribution	Galvanized Steel ⁽²⁾	Low Pressure
Exhaust Air Distribution	Galvanized Steel	Medium Pressure
General Exhaust Vertical Riser to Fan	Galvanized Steel	Medium Pressure
Kitchen Hood Exhaust	Black Steel	Medium Pressure ⁽³⁾
Dishwasher Exhaust	316L Stainless Steel	Medium Pressure
General Lab Exhaust Air Device to Horizontal Distribution	Galvanized Steel	Low Pressure
Hood/Biosafety Cabinet Exhaust to Horizontal Distribution	316L Stainless Steel	Medium Pressure





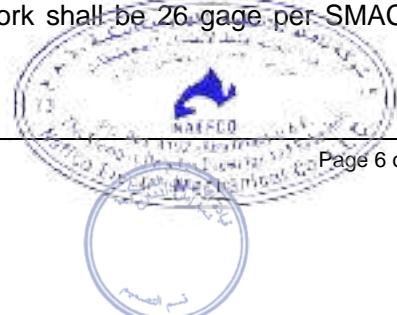
AIR SYSTEM	MATERIAL	MINIMUM PRESSURE CLASSIFICATION ⁽¹⁾
Combination Lab and General Exhaust Horizontal Distribution (Serving General Exhaust and 3 or fewer CFHs)	316L Stainless Steel	Medium Pressure(4)
Combination Lab and General Exhaust Horizontal Distribution (Serving General Exhaust and 4 or more CFHs)	Galvanized Steel	Medium Pressure ⁽⁴⁾
Combination Lab and General Exhaust Vertical Riser	Galvanized Steel	Medium Pressure ⁽⁴⁾
Combination Lab and General Exhaust Riser to Filter Housing/Exhaust Plenum	Galvanized Steel	Medium Pressure ⁽⁴⁾
Combination Lab and General Exhaust Fan to Exhaust Stack (including Exhaust Stack)	316L Stainless Steel	Medium Pressure ⁽⁴⁾
Emergency Generator Exhaust	Double Wall or Black Steel	As Specified
MRI Cryogen Vents	304 Stainless Steel or 6061 Aluminum	As Specified
Vivarium General Exhaust Air Valve to Air Device	316L Stainless Steel ⁽⁵⁾	Low Pressure

B. Notes to Table:

1. Positive pressure unless noted otherwise in Table.
2. Air device connections may be made with insulated flexible duct as specified herein.
3. Verify minimum pressure classification per NFPA 96 requirements.
4. Applies to exhaust system for general laboratory exhaust, fume hoods, and biosafety cabinets. Refer to Drawings for construction of any additional exhaust systems.
5. Where ductwork systems are subject to routine decontamination, provide 316L stainless steel ductwork as indicated.

2.3 DUCTWORK MATERIAL AND CONSTRUCTION

- A. All ductwork indicated on the Drawings, specified or required for the air conditioning and ventilating systems shall be of materials as hereinafter specified unless indicated otherwise on Drawings. All air distribution ductwork shall be fabricated, erected, supported, etc., in accordance with all applicable standards of SMACNA where such standards do not conflict with NFPA 90A and where class of construction equals or exceeds that noted herein.
- B. Ductwork shall be constructed of G-90 coated galvanized steel of ASTM A653 and A924 Standards.
- C. Minimum gage of round, oval or rectangular ductwork shall be 26 gage per SMACNA Standards.

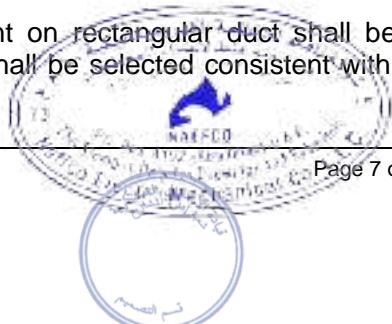




- D. All duct sizes shown on the Drawings are clear inside dimensions. Allowance shall be made for internal lining, where specified, to provide the required free area.
- E. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for future connections/phases, otherwise plastic covers are acceptable.
- F. Except for specific duct applications specified herein, all sheet metal shall be constructed from prime galvanized steel sheets and/or coils up to 60 inches in width. Each sheet shall be stenciled with manufacturer's name and gage.
- G. Sheet metal must conform to SMACNA sheet metal tolerances as outlined in SMACNA's "HVAC Duct Construction Standards."
- H. Where ducts are exposed to view (including equipment rooms) and where ducts pass through walls, floors or ceilings; furnish and install sheet metal collars around the duct.
- I. Spin-in fittings shall be as specified under Section 23 33 00 – Ductwork Accessories.
- J. Duct Sealing: All ductwork, regardless of system pressure classification, shall be sealed in accordance with Seal Class A, as referenced in SMACNA Standards. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.
 - 1. All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3 inches wide open weave fiberglass scrim tape. Sufficient additional sealant shall then be applied to completely embed the cloth.
 - 2. Sealant shall be water based latex UL 181A-M sealant with flame spread of 0 and smoke developed of 0. Sealants shall be Hard Cast Iron Grip 601, Ductmate Pro Seal, Foster 32-19, Childers CP-146 or Design Polymerics DP 1010.
 - 3. Scrim tape shall be fiberglass open weave tape, 3 inches wide, with maximum 20/10 thread count, similar to Hardcast FS-150.
 - 4. Sealer shall be rated by the manufacturer and shall be suitable for use at the system pressure classification of applicable ductwork.
 - 5. Except as noted, oil or solvent-based sealants are specifically prohibited.
 - 6. For exterior applications, "Uni-Weather" (United McGill Corporation), solvent-based sealant, or Foster 32-19 shall be used.

2.4 RECTANGULAR AND ROUND DUCTWORK

- A. Metal gages listed in SMACNA HVAC Duct Construction Standards, Metal and Flexible Duct, are the minimum gages which shall be used. Select metal gage heavy enough to withstand the physical abuse of the installation. In no case shall ductwork be less than 26 gage per SMACNA Standards.
- B. All longitudinal seams for rectangular duct shall be selected for the specified material and pressure classification. Seams shall be as referenced in SMACNA Standards.
- C. Longitudinal seams in laboratory hood exhaust ducts shall be welded.
- D. All transverse joints and intermediate reinforcement on rectangular duct shall be as shown in SMACNA Standards. Transverse joints shall be selected consistent with the





specified pressure classification, material, and other provisions for proper assembly of ductwork.

- E. Spiral round duct and fittings shall be as manufactured by United McGill Sheet Metal Company or approved equivalent. All fittings shall be factory fabricated, machine formed and welded from galvanized sheet metal.
- F. Joints in spiral duct and fittings shall be assembled, suspended, sealed, and taped per manufacturer's published assembly and installation instructions.
- G. Contractor may use DUCTMATE or Ward Industries coupling system, as an option, on rectangular ductwork. The DUCTMATE or Ward Industries system shall be installed in strict accordance with manufacturer's recommendations.
- H. Rectangular ductwork field fabricated offsets shall not exceed 30 degrees.

2.5 FLAT OVAL DUCTWORK AND FITTINGS

- A. Oval ducts shall be spiral flat oval or welded flat oval equivalent to those of United McGill Sheet Metal Company with gage and reinforcing as recommended by the manufacturer. Duct may be shop fabricated of completely welded construction in accordance with SMACNA Standards.
- B. Oval ducts greater than 24 inch x 72 inch shall be longitudinal seam, flat oval duct, rolled, welded and provided in standard lengths of 5 and 10 feet. Transverse joints shall be factory welded or field connected with flanges or slip couplings. Duct will be fabricated from galvanized steel meeting ASTM A 527 standards.
- C. Duct reinforcing angles shall be of sizes specified for same size rectangular duct. Galvanized angles shall be used where standing seams are specified for rectangular duct.
- D. Oval fittings shall comply with requirements, sealing, etc., similar to that specified for round ductwork. Manifolding taps may be permitted without increasing the length of run in the branch duct system.
- E. Elbows in oval ducts may be smooth long radius or 5-piece 90-degree elbows and 3-piece 45-degree elbows. Joints in sectional elbows shall be sealed as specified for duct sealing.

2.6 CONICAL BELLMOUTH FITTINGS AND TAPS

- A. Conical bellmouth fittings shall be made from 26-gage G-90 coated galvanized steel. Two-piece construction with a minimum overall length of 6 inches and factory sealed for high-pressure requirements. Average of loss coefficient for sizes 6, 8 and 10 shall be less than 0.055.
- B. Provide each fitting with minimum 24-gage damper plate with locking quadrant operator and sealed end bearings. Damper blade shall be securely attached to shaft to prevent damper from rotating around shaft. Shaft shall be extended to clear insulation.
- C. Provide a flange and gasket with adhesive peel-back paper for ease of application. The fittings shall be further secured by sheet metal screws spaced evenly at no more than 4 inches on center with a minimum of four (4) screws per fitting.





- D. Conical bellmouth fittings shall be Series 3000G as manufactured by Flexmaster U.S.A., Inc. or Buckley Air Products, Inc., "AIR-TITE".

2.7 CASINGS AND PLENUMS - 2 INCH W.G. PRESSURE CLASS

- A. All 2 inch w.g. pressure class casings and plenums for mixed air plenums shall be constructed in accordance with SMACNA Standards.
- B. All casings shall enclose the filter and automatic dampers as shown on the Drawings. Casings shall be fabricated of galvanized sheet metal erected with three-foot center maximum standing seams reinforced with ¼-inch bars. The casing shall be stiffened on three-foot centers maximum with angle irons tack welded in place.
- C. All openings to the casing shall be properly sealed to prevent any air leakage. Access doors shall be installed as indicated on the Drawings and shall be air tight, double skin insulated construction with frames welded in place. Doors shall be rubber gasketed with #390 Ventlok gasketing and equipped with fasteners equal to Ventlok #310 latches and #370 hinges that can be operated from both the inside and the outside.
- D. Casings shall be anchored by the use of angle irons sealed and bolted to the curb and floor of the apparatus casing. Casings shall be tested and provided tight at a pressure of three inches water column.
- E. Insulate per Section 23 07 13.

2.8 CASINGS AND PLENUMS – 6 INCH W.G. PRESSURE CLASS

- A. Shall enclose filters and automatic dampers at air handling unit systems. Casings shall be constructed of cellular, standing seam panels with 3 inch deep reinforced "hat" sections as manufactured by metal deck manufacturers and as described in SMACNA Standards.
- B. All openings to the casing shall be properly sealed to prevent air leakage. Install access doors for easy access to equipment. Access doors shall be air tight, double skin insulated construction with frames welded in place. Doors shall be rubber gasketed with #390 Ventlok gasketing and equipped with fasteners equal to Ventlok #310 latches that can be operated from both the inside and outside. Hinges shall be equivalent to Ventlok #370.
- C. Anchor casing by the use of galvanized angle irons sealed and bolted to the curb and floor of the apparatus casing as indicated in SMACNA Standards.
- D. A fan discharge diffuser plate shall be located on the fan discharge and shall be constructed of 10 gage steel perforated plate installed in 6 inch channel iron frames (8.2#) rigidly supported to withstand the fan discharge velocity. Perforations shall be 3/8 inch (0.375 inch) staggered on 11/16 inch centers (27 percent open area). One section shall be hinged to provide an access door between the discharge side of the fan and the entering side of the coils. After fabrication of the diffuser plate, coat with rust-resistant paint. After installation, touch up diffuser plate and paint channel iron frames with rust-resistant paint.
- E. Provide sufficient access openings to allow access for maintenance of all parts of the apparatus. Access door size shall be as large as feasible for the duty required.





F. Insulate per Section 23 07 13.

2.9 ELBOWS RECTANGULAR DUCTS

A. Construct elbows as follows in order of preference:

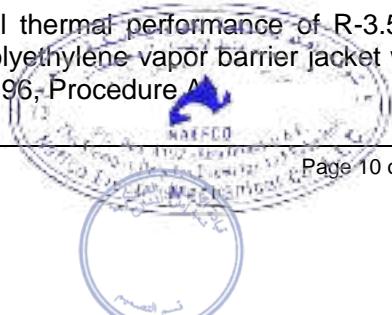
1. Long radius, unvaned elbows.
 2. Short radius, single thickness vanned elbows.
 3. Rectangular, double thickness vanned elbows.
- B. Long radius elbows shall have a centerline radius of not less than one and one-half (1-1/2) times the duct width. Short radius elbows shall have a centerline radius of not less than one times the duct width.
- C. Contractor shall have the option to substitute short radius vanned elbows, but shall request the substitution at the time of submittal of Product Data.
- D. Provide turning vanes in all rectangular elbows and offsets.
- E. Job fabricated turning vanes, if used, shall be fabricated of the same gage and type of material as the duct in which they are installed. Vanes must be fabricated for same angle as duct offset. Submit Shop Drawings on factory fabricated and job fabricated turning vanes.
- F. All turning vanes shall be anchored to the cheeks of the elbow in such a way that the cheeks will not breathe at the surfaces where the vanes touch the cheeks. In most cases, this will necessitate the installation of an angle iron support on the outside of the cheek parallel to the line of the turning vanes.
- G. In 90-degree turns that are over 12 inches wide in the plane of the turn, provide and install double thickness vanes on integral side rails. For ducts under 12 inches in width, use single thickness vanes. The installation of the turning vanes shall be as described for single thickness vanes. On other types of turns or elbows, single thickness trailing edge vanes shall be used.

2.10 FLEXIBLE DUCT

A. Flexible duct shall be used where flexible duct connections are shown on the Drawings to air distribution devices and terminal units and as scheduled under "Ductwork System Applications."

B. Acoustical Flexible Duct to Diffusers, Grilles, and Terminal Units:

1. Maximum flex duct length 6'-0" (six feet), installed with no more than 90 degrees of bend to diffusers and grilles. Where longer duct runs or more bends are necessary, provide rigid round ductwork.
2. Maximum flex duct length 2'-0" (two feet), installed as a straight run to the inlet of the terminal units.
3. Acoustical flexible duct shall be manufactured with an acoustically rated CPE inner film as the core fabric, mechanically locked by a corrosion-resistant galvanized steel helix.
4. Core shall be factory pre-insulated with a total thermal performance of R-3.5 or greater. Outer jacket shall be a fire retardant polyethylene vapor barrier jacket with a perm rating not greater than 0.10 per ASTM E 96, Procedure A.





5. Duct shall be rated for a minimum positive working pressure of 6 inches w.g. and a negative working pressure of 4 inches w.g. minimum.
 6. Temperature range shall be -20 degrees F to 250 degrees F.
 7. Duct must comply with the latest NFPA Bulletin 90A and be listed and labeled by Underwriter's Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA and other U. S. Government standards; flame spread less than 25; smoke developed less than 50.
 8. Acoustical flexible duct shall be similar to Flexmaster Type 8M for construction and acoustical performance standards.
- C. Metal Flexible Duct:
1. May be used for terminal unit connections from sheet metal ductwork where shown on the Drawings.
 2. Maximum length 2'-0" (two feet), installed in straight runs only. Where longer duct runs or direction changes are necessary, provide rigid round ductwork.
 3. Duct shall be constructed of 0.005 inch thick 3003-H14 aluminum alloy in accordance with ASTM B209. Duct shall be spiral wound into a tube and spiral corrugated to provide strength and flexibility.
 4. Core shall be factory pre-insulated with a total thermal performance of R-3.5 or greater. Outer jacket shall be fire retardant metallized vapor barrier jacket of fiberglass reinforced aluminum foil, with a permeance rating not greater than 0.05 per ASTM E96, Procedure A.
 5. The duct shall be rated for a minimum positive and negative working pressure of 10 inch w.g.
 6. Temperature range shall be -40 degrees F to 250 degrees F.
 7. Duct must comply with the latest NFPA Bulletin 90A and be listed and labeled by Underwriter's Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA and other U. S. Government standards; flame spread less than 25; smoke developed less than 50.
 8. Metal flexible duct shall be similar to Flexmaster triple lock Type TL-M.

2.11 STAINLESS STEEL DUCTWORK

- A. Applies to general laboratory exhaust, fume hood, biosafety cabinet, radioisotope hood, vivarium supply and exhaust systems subject to routine decontamination (HPV, Clidox, etc.), and moisture exhaust systems where indicated on the Drawings and as specified herein.
- B. Stainless steel shall be 316-L with welded longitudinal seams and welded transverse joints. Welds on exposed ductwork shall be positioned for minimum view and shall be ground and polished. Duct sealant shall not be used to seal this ductwork.
- C. All ductwork risers shall be installed as vertical as possible within the constraints of the design indicated on the Drawings.
- D. In all cases, ductwork shall be installed so that the washdown water, where installed, shall drain back to the hood.
- E. Metal gages shall be not less than the following:

DUCT SIZE	GAGE
30-inch diameter or less	18
31-inch to 60-inch diameter	16





DUCT SIZE	GAGE
61-inch diameter or greater	14
Greater than 60 x 42 (rectangular or oval)	Comply with SMACNA

- F. The joining of stainless steel ductwork with galvanized ductwork where indicated in the Drawings shall use ductwork construction methods specified herein for galvanized ductwork.
- G. Connections to Air Devices Cabinets or Hoods:
 - 1. Where approved by CMW, flexible stainless steel ducting can be used in lieu of hard pipe stainless steel at cabinets or hoods
 - 2. For all non insulated duct applications flexible ducting shall be 316TI stainless steel; pressure rated for 12 inches w.g. positive and negative; UL 181, Class 0 air duct rated; Velocity Rated for 5500 fpm. Similar to Flexmaster Type SS-NI-TL.
 - 3. For all insulated duct applications, flexible ducting shall be 316 stainless steel; pressure rated for 12 inches w.g. positive and negative; UL 181, Class 1 air duct rated; Velocity Rated for 5500 fpm. Similar to Flexmaster Type SS-TLM.

2.12 ALUMINUM DUCTWORK

- A. Provide 6061 Aluminum ductwork only where indicated on the Drawings and as specified herein. Applies typically to ductwork within MRI rooms.
- B. Duct joints shall be all soldered construction, one standard gage heavier than for the same size galvanized steel ducts. Refer to SMACNA for equivalent aluminum thickness and reinforcement.
- C. Construction method shall follow the specified methods for galvanized ductwork, except that no ferrous materials may be used. Only aluminum, copper and brass must be used in construction in locations requiring aluminum ductwork; this includes fasteners, hangers, anchors, etc.
- D. Connections to Equipment:
 - 1. Where approved by CMW, flexible stainless steel ducting can be used in lieu of hard pipe stainless steel.
 - 2. Flexible ducting shall be 316 TI stainless steel; pressure rated for 12 inches w.g. positive and negative; UL 181, Class 0 air duct rated; Velocity Rated for 5500 fpm. Similar to Flexmaster Type SS-NL-TL.

2.13 KITCHEN HOOD EXHAUST

- A. Stainless steel with liquid tight welded longitudinal seams and transverse joints, as specified under "Stainless Steel Ductwork" and as further specified herein.
- B. Construction shall be in accordance with NFPA 96 and applicable SMACNA Standards.
- C. Slope duct toward hood connections and cleanout points as shown on the Drawings.
- D. No turning vanes, dampers, or other interior intrusions shall be installed in the ductwork system.

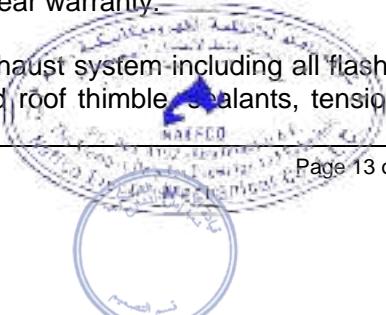




- E. All changes in direction shall be with radius elbows (centerline radius equal 1.5 x duct width).
- F. Provide rated access doors for installation by the Contractor at all locations necessary.
- G. Coordinate required rated enclosure of kitchen hood exhaust and access points with the Contractor.
- H. Manufactured double wall duct systems with NFPA certification for grease systems may be used in lieu of above referenced materials.

2.14 EMERGENCY GENERATOR EXHAUST SYSTEM

- A. Selkirk Metalbestos (Model IPS-C2), Metal Fab. Minimum standard weight black steel pipe with calcium silicate insulation is acceptable in lieu of double wall system specified herein.
- B. Factory-built modular exhaust system and published skin temperatures shall be laboratory tested and listed by Underwriters Laboratories, Inc., for use with building heating equipment and appliances which produce exhaust flue gases at temperature not exceeding 1400 degrees F under continuous operating conditions. This exhaust system shall be designed to compensate for all flue gas induced thermal expansions.
- C. Exhaust system shall be double wall and have an outer jacket of Type 316 stainless steel, 0.025 inch thick in 6 inch through 24 inch diameter and 0.034 inch thick for larger diameter duct. The inner flue gas carrying conduit shall be Type 316 stainless steel. The inner liner shall be 0.035 inch nominal thickness for all duct diameters.
- D. To control the venting pressure should a backfire occur, an explosion relief valve shall be incorporated in the exhaust system per NFPA 37.
- E. Fiber insulated exhaust system shall have a fiber insulation between the walls of 2 inches thick. Asbestos materials may not be used.
- F. Inner pipe joints shall be sealed by use of overlapping type V-band (P-OVB) with a premixed 200 degrees F sealant (P-200E). The outer channel bands shall be sealed with a 600 degrees F sealant (P-600) where exposed to weather.
- G. When the engine exhaust system is installed according to the manufacturer's installation instructions and the limits of its listing, it shall comply with National Safety Standards and Building Codes.
- H. Exhaust system shall terminate as shown on the Drawings and per NFPA 37 and NFPA 211 requirements.
- I. All exhaust system parts exposed to the atmosphere shall be protected by a minimum of one base coat and one finished coat of paint, such as Series 4200 or 4300 heat resistance paint as manufactured by Rust-Oleum Corp.
- J. The exhaust system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's 10-year warranty.
- K. Furnish all parts required to completely install the exhaust system including all flashing, storm collar, miter cuts, supports, bracing, ventilated roof thimble, sealants, tensioner,

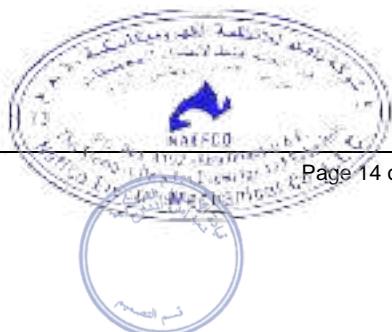




wall guide, rings, tee cap, adapter, bellows, etc. Coordinate installation with roofing Contractor.

2.15 MRI CRYOGEN VENT PIPE

- A. For cryogenic venting, welded stainless steel or aluminum pipe shall be used in all MRI or similar rooms where shown on the Drawings.
- B. Stainless steel pipe shall be Type 304 non-ferromagnetic, thickness 0.035 inch minimum and 0.125 inch maximum.
- C. Aluminum pipe shall be Type 6061-T6, thickness 0.083 inch minimum and 0.125 maximum.
- D. Piping shall be installed with bracing as required to withstand the forces encountered during a cryogenic release event.

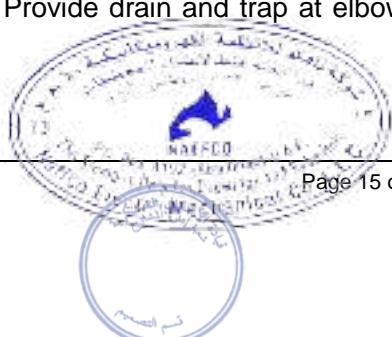




PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Cleanliness:
 1. Before installing ductwork, wipe ductwork to a visibly clean condition.
 2. During construction, provide temporary closures of metal or taped polyethylene on open ductwork and duct taps to prevent construction dust or contaminants from entering ductwork system. Seal ends of ductwork prior to installation to keep ductwork interior clean. Remove closures only for installation of the next duct section.
 3. For ductwork supplying Clean Rooms, Operating Rooms and other Critical Care areas, sanitize ductwork with a biocidal agent EPA approved for HVAC systems immediately prior to sealing ductwork.
 4. During duration of construction, maintain the integrity of all temporary closures until air systems are activated.
- D. Provide openings in ductwork where required to accommodate thermometers, controllers and other devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring. Sleeve of pitot tube opening shall be no more than one inch long. Opening shall be one inch wide to accept pitot tube.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Slope underground ducts to plenums or low pump out points at 1:500. Provide access doors for inspection.
- G. Coat buried, metal ductwork without factory jacket with one coat and seams and joints with additional coat of asphalt base protective coating.
- H. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- I. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use stainless steel for ductwork exposed to view and stainless steel for ducts where concealed.
- J. All visible welds in ductwork between biosafety cabinets, canopy hoods and fume hoods and the ceiling shall be ground and polished.
- K. Slope duct toward grilles for moisture-laden ducts. Provide drain and trap at elbow of main moisture exhaust duct system.





- L. Project inspector shall be notified to inspect all field fabricated offsets before cover-up or external insulation is applied.
- M. Flexible Duct:
 - 1. The terminal ends of the duct core shall be secured by compression coupling or stainless steel worm gear type clamp.
 - 2. Fittings on terminal units and on sheet metal duct shall have flexible duct core slipped over duct and coupling or clamp tightened, then connection sealed with sealant. Insulation of flexible duct shall be slipped over connection to point where insulation abuts terminal unit or insulation on duct.
 - 3. These insulation connections shall be sealed by embedding fiberglass tape in the sealant and coating with more sealant to provide a vapor barrier.
- N. Support flexible ducts as per SMACNA standards to prevent sags, kinks and to have 90 degree turns.
- O. Hangers and Supports:
 - 1. All ductwork supports shall be in accordance with Table 4-1 (rectangular duct) and Table 4-2 (round duct) of the SMACNA Standards, with all supports directly anchored to the building structure.
 - 2. Rectangular duct shall have at least one pair of supports on minimum 8'-0" (eight feet) centers. All horizontal round and flat oval ducts shall have ducts hangers spaced 10'-0" (ten feet) maximum.
 - 3. Lower attachment of hanger to duct shall be in accordance with Table 4-4 of the SMACNA Standards.
 - 4. Vertical ducts shall be supported where they pass through the floor lines with 1-1/2 inch x 1-1/2 inch x 1/4 inch angles for duct widths up to 60 inches. Above 60 inches in width, the angles must be increased in strength and sized on an individual basis considering space requirements.
 - 5. Hanger straps on duct widths 60 inches and under shall lap under the duct a minimum of 1 inch and have minimum of one fastening screw on the bottom and two on the sides.
 - 6. Hanger straps on duct widths over 60 inches shall be bolted to duct reinforcing with 3/8 inch bolts minimum.

3.2 DUCTWORK SYSTEM CLEANING

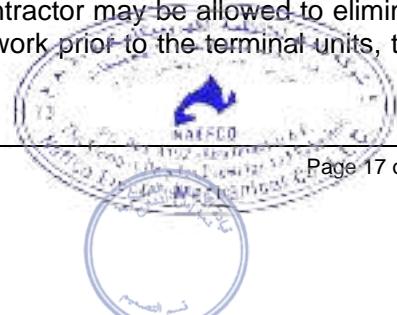
- A. If the system has been operated without scheduled filters or if the integrity of temporary closures has been compromised, Contractor shall have ductwork cleaned according to National Air Duct Cleaners Association (NADCA) Standards by a Certified Regular Member of the NADCA.
 - 1. For ductwork supplying Clean Rooms or patient care areas, also sanitize the ductwork interior per NADCA standards with a biocidal agent approved by the EPA for use in HVAC Systems.
- B. Before turning the installation over to CMW, Contractor shall certify that the air handling systems have only been operated with scheduled filters in place. Otherwise, Contractor shall present evidence that the ductwork was cleaned as required above.





3.3 TESTING

- A. All medium and high pressure duct systems (positive or negative) shall be pressure tested according to SMACNA test procedures (HVAC Air Duct Leakage Test Manual). Notify CMW minimum seven (7) calendar days in advance of leakage testing.
 1. Design pressure for testing ductwork shall be determined from the maximum pressure generated by the fan at the nominal motor horsepower selected.
 2. Total allowable leakage shall not exceed 1 percent of the total system design airflow rate.
 3. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
 4. Leaks identified during leakage testing shall be repaired by:
 - a. Complete removal of the sealing materials.
 - b. Thorough cleaning of the joint surfaces.
 - c. Installation of multiple layers of sealing materials.
 5. The entire ductwork system shall be tested, excluding connections upstream of the terminal units (i.e. ductwork shall be capped immediately prior to the terminal units, and tested as described above).
 6. After testing has proven that ductwork is installed and performs as specified, the terminal units shall be connected to ductwork and connections sealed with extra care. Contractor shall inform CMW when joints may be visually inspected for voids, splits, or improper sealing of the joints. If any leakage exists in the terminal unit connections/joints after the systems have been put into service, leaks shall be repaired as specified for other leaks.
 7. Fixed flow measurement devices (i.e. orifice tubes, nozzles, etc.) shall have current calibration documentation showing that the device was verified to a National Institute Of Standards and Technology (NIST) standard within the previous five years or as recommended by the manufacture and be accurate to at least +/- 2% of reading.
 8. Pressure measurement instrumentation (i.e. manometer) shall have current calibration documentation showing that the device was verified to a NIST standard within the previous year or as recommended by the manufacture. Instrumentation shall have an accuracy of at least +/- 2% of reading and have a resolution of 2:1 with respect to the measured pressure (i.e. resolution of 0.01 measured 0.1).
- B. All low-pressure duct systems (positive or negative) shall be inspected for visible and audible signs of leakage.
 1. Leaks identified by inspection shall be repaired by:
 - a. Complete removal of the sealing materials.
 - b. Thorough cleaning of the joint surfaces.
 - c. Installation of multiple layers of sealing materials.
 2. Discrepancies found during testing and balancing between duct traverses and diffuser/grille readings shall result in re-inspection, repair and retest until discrepancies are eliminated.
- C. At the option of CMW, if documented in writing, Contractor may be allowed to eliminate testing of terminal units by capping the supply ductwork prior to the terminal units, then



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inspecting the connection to the terminal units when complete. This option may only be exercised by CMW, only if documented in writing prior to testing.]

- D. Ductwork leakage testing and/or inspection shall be performed prior to installation of external ductwork insulation.

- End of Section -



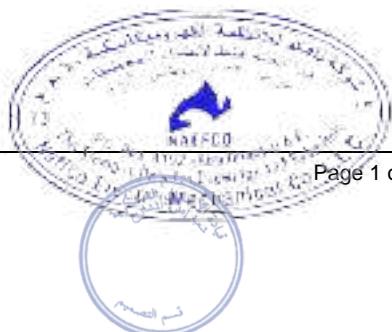


23 33 00

DUCTWORK ACCESSORIES

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CMW GENERAL SPECIFICATION
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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.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. Perform all Work required to provide and install the following ductwork accessories indicated by the Contract Documents with supplementary items necessary for proper installation.
 1. Airflow control dampers and spin-in fittings.
 2. Fire dampers, smoke dampers, and combination fire and smoke dampers.
 3. Flexible duct connections.
 4. Duct access doors.
 5. Screens
 6. Duct test holes.
 7. Guy wire systems.

1.3 REFERENCE STANDARDS

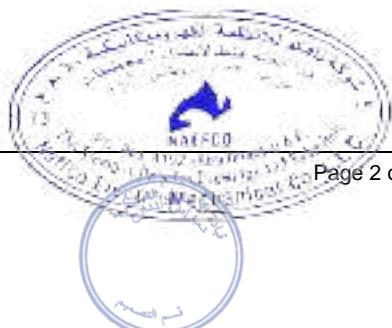
- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 1. AMCA 500D – Laboratory Method of Testing Dampers for Rating.
 2. AMCA 500L – Laboratory Method of Testing Louvers for Rating.
 3. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
 4. NFPA 101 - Life Safety Code.
 5. SMACNA - HVAC Duct Construction Standards.
 6. UL 33 - Heat Responsive Links for Fire-Protection Service.
 7. UL 555 – Standard for Fire Dampers.
 8. UL 555C – Standard for Ceiling Dampers.
 9. UL 555S – Standard for Smoke Dampers.

1.4 SUBMITTALS

A. Product Data:

1. Provide product data for shop fabricated assemblies including, but not limited to, volume control dampers, duct access doors, and duct test holes. Provide product data for hardware used.

B. Record Documents:

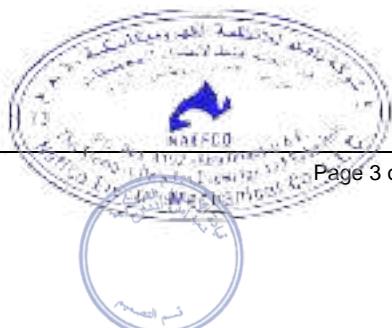


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2. Fire Dampers: The damper manufacturer's literature submitted for approval prior to the installation shall include performance data developed from testing in accordance with AMCA 500D standards and shall show the pressure drops for all sizes of dampers required at anticipated air flow rates. Maximum pressure drop through fire damper shall not exceed 0.05-inch water gauge.
3. Combination Fire/Smoke Dampers: Assign identification numbers for each damper with corresponding number noted on Drawings. Provide air quantity, size, free area of damper, pressure drop and proposed velocity through each damper. Provide manufacturer's data of damper and its accessories or options. At Owner's request, provide two (2) dampers (18 inch x 12 inch) for the purpose of illustrating damper operation to Owner's operating and maintenance personnel.





PART 2 PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 AIR FLOW CONTROL DAMPERS

- A. Furnish and install dampers where shown on the Drawings and wherever necessary for complete control of airflow, including all supply, return, outside air, and exhaust branches, "division" in main supply, return and exhaust ducts, and each individual air supply outlet. Where access to dampers through a permanent suspended ceiling (gypsum board) is necessary, the Contractor shall be responsible for the proper location of the access doors.
- B. Dampers larger than three (3) square feet in area shall be controlled by a self-locking splitter damper assembly.
- C. Volume damper blades shall not exceed 48 inches (48") in length or twelve inches (12") in width and shall be of the opposed interlocking type. The blades shall be of not less than No. 16 gage galvanized steel supported on one-half inch (1/2") diameter rust-proofed axles. Axle bearings shall be the self-lubricating ferrule type.
- D. Volume dampers and other manual dampers shall be carefully fitted, and shall be manually controlled by damper regulators as follows:
1. On exposed uninsulated ductwork the locking quadrant shall be made with a base plate of 16-gage cold-rolled steel and a heavy die cast handle designed with a 3/8 inch bearing surface. A 1/4 inch-20 zinc plated wing nut shall firmly lock the handle in place.
 2. On exposed externally insulated ductwork the regulator shall be 4-1/4 inch diameter, for 1/2 inch rod, designed for use on duct with insulation thickness specified for duct, and shall have four (4) 3/16 inch holes provided to rivet or screw regulator to the duct surface. The flange that covers the raw edge of the insulation shall be high enough so that it slightly compresses the insulation and holds insulation in place. The handle shall be 3/8 inch above the flange, and shall easily turn without roughing up the insulation.
 3. On concealed ductwork above inaccessible ceilings, the regulator shall be 2-5/8 inch diameter chromium plated cover plate that telescopes into the base, for 1/2 inch rod. Regulator shall be cast into a box for mounting in ceilings. Base shall be 1-1/2 inch deep. The cover shall be secured by two screws that can be easily removed for damper adjustment.
 4. Furnish and install end bearings for the damper rods on the end opposite the quadrant.
- E. Spin-in fittings may be used for duct taps to air devices and shall include dampers on all duct to air devices (diffusers and grilles) even though a volume damper is specified for the air device. Spin-in fittings shall be similar to Flexmaster FLD with BO3 including a 2 inch buildup, nylon bushings, locking quadrant similar to Duro Dyne KR-3, and a 3/8 inch square rod connected to the damper with U-bolts. Spin-in fittings shall be sealed at the duct tap with sealant as specified herein. Determine location of spin-in fittings after terminal units are hung or after location of light fixtures are confirmed to minimize flexible duct lengths and sharp bends.



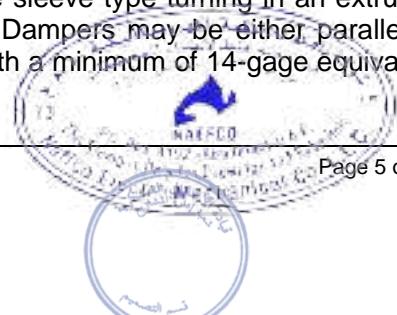


2.3 FIRE DAMPERS

- A. Each fire damper shall be constructed and tested in accordance with Underwriters Laboratories Safety Standard 555, latest edition. Dampers shall possess a 1-1/2 hour or 3 hour (as appropriate for the construction shown in the architectural Drawings) protection rating, 160 or 165 degrees F fusible link, and shall bear a U.L. label in accordance with Underwriters' Laboratories labeling procedures. Construct fire dampers such that damper frame material and curtain material are galvanized.
- B. Fire dampers shall be curtain blade type and damper shall be constructed so that the blades are out of the air stream to provide 100 percent free area of duct in which the damper is housed.
- C. Equip fire dampers for vertical or horizontal installation as required by location shown on Drawings. Install fire dampers in wall and floor openings utilizing steel sleeves, angles and other material and practices as required to provide an installation equivalent to that utilized by the manufacturer when the respective dampers were tested by Underwriters Laboratories. Mounting angles shall be minimum 1-1/2 inch by 1-1/2 inch by 14 gage and bolted, tack welded or screwed to the sleeve at maximum spacing of 12 inches and with a minimum of two connections at all sides. Mounting angles shall overlap at least equal to the duct gage as defined by the appropriate SMACNA Duct Construction Standard, latest edition, and as described in NFPA 90A. The entire assembly, following installation, shall be capable of withstanding 6 inch water gauge static pressure.
- D. All fire dampers shall be dynamic rated type.
- E. Completely seal the damper assembly to the building components using manufacturer recommended material(s).

2.4 COMBINATION FIRE/SMOKE DAMPERS

- A. Provide one damper motor for each 12 square feet of damper area.
- B. Each combination fire/smoke damper shall be 1-1/2 hour fire rated under UL Standard 555, Current Edition, and shall be further classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested and qualified with UL, a complete range of damper sizes covering all dampers required by this Specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be no higher than Leakage Class II (4 CFM per square foot at one-inch water gauge pressure and 8 CFM per square foot at 4 inches water gauge pressure). Maximum air pressure drop through each combination fire/smoke damper shall not exceed 0.10-inch water gauge at the design air quantity. (Note that this may require a larger damper than the connected duct size.) All ratings shall be dynamic.
- C. Damper frame shall be minimum 20-gage galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in an extruded hole in the frame or an extruded frame raceway. Dampers may be either parallel or opposed blade type. Blades shall be constructed with a minimum of 14-gage equivalent





thickness. Blade edge seal material shall be able to withstand 450 degrees F. Jamb seals shall be flexible stainless steel compression type or lap seal type.

- D. In addition to the leakage ratings specified herein, combination fire/smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Electric operators shall be installed by the damper manufacturer at the time of damper fabrication. Damper and operator shall be supplied as a single entity that meets all applicable UL555 and UL555S qualifications for both dampers and operators. Manufacturer shall provide a factory-assembled sleeve. Sleeve shall be minimum 20-gage for dampers where neither width nor height exceeds 48 inches or 16-gage where either dimension equals or exceeds 48 inches.
- E. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures at least 4 inches water gauge in the closed position, and 2500 fpm air velocity in the open position.
- F. Each combination fire/smoke damper, except as noted hereinafter, shall be equipped with a UL Classified firestat/releasing device. The firestat/releasing device shall electrically (24 VAC) and mechanically (pneumatically) lock the damper in a closed position when the duct temperatures exceed 165 degrees F and still allow the appropriate authority to operate the damper as may be required for smoke control functions. Damper must be operable while the temperature is above 350 degrees F. Actuator/operator package shall include two damper position indicator switches linked directly to damper blade to provide capability of remotely indicating damper position. One switch shall close when the damper is fully open, and the other switch shall close when the damper is fully closed. The firestat/releasing device and position indicator switches shall be capable of interfacing electrically with the smoke detectors, building fire alarm system, and remote indicating/control stations or building automation system (BAS).
- G. Damper releasing device shall be mounted within the airstream. Device shall be activated and the damper shall close and lock when subjected to duct temperatures in excess of approximately 285 degrees F.
- H. Motors for operation of smoke dampers shall be smoke system fail safe, spring return normally open supplies and normally closed returns, or as indicated on the Drawings, and shall be furnished and installed by the damper manufacturer as required by the U.L. rating mentioned above. Motors shall be electric or pneumatic to match the type of temperature control system specified elsewhere in this Specification. Furnish all required relays, EP switches, wiring piping and other labor and material necessary to completely interconnect the smoke detector system.
- I. Furnish each damper in a square or rectangular configuration. Furnish and install sleeves manufactured by the approved damper manufacturer for each damper. Construct sleeves with square or rectangular to square, rectangular, round, or oval adapters as required. Dampers shall be installed in the sleeves in accordance with manufacturer's U.L. installation instructions. The entire assembly, following installation, shall operate smoothly and be capable of withstanding 6 inch water gauge static pressure.

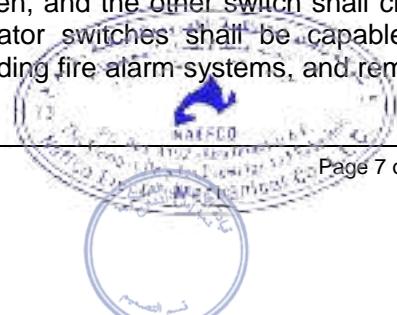




- J. Each combination fire/smoke damper shall be equipped with a Damper Test Switch. The damper test switch will have the ability to "cycle test" the fire/smoke damper by pushing and holding the test button until the damper has cycled.
- K. All combination fire/smoke dampers shall be dynamic type.
- L. Completely seal the damper assembly to the building components using manufacturer recommended material(s).

2.5 SMOKE DAMPERS

- A. Provide one damper motor for each 12 square feet of damper area.
- B. Each smoke damper shall be dynamic rated type and shall be further classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this Specification. Testing and UL qualifying a single damper size is not acceptable. Leakage rating under UL555S shall be no higher than Leakage Class II (4 CFM per square foot at one-inch water gauge pressure and 8 CFM per square foot at 4 inches water gauge pressure). Maximum air pressure drop through each smoke damper shall not exceed 0.10-inch water gauge at the design air quantity. (Note that this may require a larger damper than the connected duct size.) All ratings shall be dynamic.
- C. Damper frame shall be minimum 0.125-inch aluminum formed into a structural hat channel shape with corner braces for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be stainless steel sleeve type turning in an extruded hole in the frame or an extruded frame raceway. Dampers shall be opposed blade type. Blades shall be airfoil shaped double skin construction. Blade edge seal material shall be silicone rubber designed to withstand 450 degrees F. Jamb seals shall be aluminum flexible metal compression type.
- D. In addition to the leakage ratings specified herein, smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Pneumatic operators shall be installed by the damper manufacturer at the time of damper fabrication. Damper and operator shall be supplied as a single entity that meets all applicable UL555 and UL555S qualifications for both dampers and operators. Manufacturer shall provide factory-assembled sleeve. Sleeve shall be minimum 21-gage for dampers where neither width nor height exceeds 48 inches or 16-gage where either dimension equals or exceeds 48 inches.
- E. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4 inches water gauge in the closed position, and 2000 fpm air velocity in the open position.
- F. The damper must be operable while the temperature is above 350 degrees F. The actuator/operator package shall include two damper position indicator switches linked directly to damper blade to provide capability of remotely indicating damper position. One switch shall close when the damper is fully open, and the other switch shall close when the damper is fully closed. Position indicator switches shall be capable of interfacing electrically with the smoke detectors, building fire alarm systems, and remote indicating/control stations (BAS).





- G. Motors for operation of smoke dampers shall be smoke system fail safe, spring return normally open supplies and normally closed returns, or as indicated on the Drawings, and shall be furnished and installed by the damper manufacturer as required by the UL rating mentioned above. Motors shall be electric or pneumatic to match the type of temperature control system specified elsewhere in this Specification. Furnish all required relays, EP switches, wiring piping and other labor and material necessary to completely interconnect the smoke detector system.
- H. Furnish each damper in a square or rectangular configuration. Furnish and install sleeves manufactured by the approved damper manufacturer for each damper. Construct sleeves with square or rectangular to square, rectangular, round, or oval adapters as required. Install dampers in the sleeves in accordance with manufacturer's UL installation instructions. Entire assembly, following installation, shall operate smoothly and be capable of withstand 6 inch water guage static pressure.
- I. Each smoke damper shall be equipped with a Damper Test Switch. The damper test switch will have the ability to "cycle test" the smoke damper by pushing and holding the test button until the damper has cycled.
- J. All smoke dampers shall be dynamic type.
- K. Completely seal the damper assembly to the building components.

2.6 FLEXIBLE CONNECTIONS

- A. Where ducts connect to, flexible connections shall be made using "Flexmaster TL-M" or "Ventglas" fabric that is temperature-resistant, fire-resistant, waterproof, mildew-resistant and practically airtight, weighing approximately thirty ounces (30 oz.) per square yard. Ventglas is good for connections for inside building environments where ultra-violet light is not present.
- B. Material used outdoors shall be resistant to ultra-violet sunrays. There shall be a minimum of one-half inch (1/2-inch) slack in the connections, and a minimum of two and one-half inches (2-1/2-inch) distance between the edges of the. This does not apply to air handling units with internal isolation. A more rugged flexible material that is resistant to ultra violet rays needs to be used when connecting an exhaust fan or exhaust air plenum to ductwork. Mercer Rubber supplies a more durable flex connection for outdoor use.
- C. Connections to Chemical Fume Hoods
- 4. Flexible connections shall be made using a coupling with stainless steel bands as manufactured by Fernco, Inc.

2.7 ACCESS DOORS

- A. Furnish and install in the ductwork, hinged rectangular, pressure relief, or round "spin-in" access doors to provide access to all fire dampers, mixed air plenums, steam reheat coils (install upstream), automatic dampers, etc.
- B. Where ductwork is insulated, access doors shall be double skin doors with one inch (1") of insulation in the door.





Section: 23 33 00 (DUCTWORK ACCESSORIES)

- C. Where duct size permits, doors shall be eighteen inches (18") by sixteen inches (16"), or eighteen inches in diameter, and shall be provided with latches (latches are not required in round doors).
- D. Latches for rectangular doors smaller than 18 inch x 16 inch shall be Ventlok No. 100 or 140.
- E. Doors for zone heating coils shall be Ventlok, stamped, insulated access doors, minimum 10 inch x 12 inch, complete with latch and two (2) hinges, or twelve inches (12") in diameter.
- F. Round access doors shall be "Inspector Series" spin-in type door as manufactured by Flexmaster USA.
- G. Doors for personnel access to ductwork shall be nominal twenty-four inches (24") in diameter. Doors may be fabricated in a local approved sheet metal shop in accordance with SMACNA Standards.
- H. Where access doors are installed above a suspended ceiling, this Contractor shall be responsible for the proper location of ceiling access doors.

2.8 SCREENS

- A. Furnish and install screens on all duct, fan, etc., openings furnished by this Contractor which lead to, or are located outdoors.
- B. Screens shall be No. 16 gage, one-half inch (1/2") mesh in removable galvanized steel frame.
- C. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

2.9 GUY WIRE SYSTEM

- A. Provide 1/4-inch diameter American Aircraft Steel Cable (plastic coated) with clip for vertical stack off utility fans on roof, with eyebolts for attachment to anchor systems on the roof.





PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.
- D. Provide all dampers furnished by the BAS Provider in strict accordance with manufacturer's written installation instruction and requirements of these Specifications.
- E. Provide fire dampers, and combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Provide backdraft dampers on exhaust fans or exhausts ducts where indicated. Install dampers so that they will open freely.
- G. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps.
- H. Provide duct access doors for inspection and cleaning before and after duct mounted filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated on Drawings. Provide minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as indicated.
- I. Provide duct test holes where indicated and where required for testing and balancing purposes.
 5. Furnish and install Ventlok No. 699 instrument test holes in the return air duct and in the discharge duct of each fan unit.
 6. Install test holes in locations as required to measure pressure drops across each item in the system, e.g., outside air louvers, filters, fans, coils, intermediate points in duct runs, etc.
- J. Access doors as specified elsewhere shall be provided for access to all parts of the fire and combination fire and smoke dampers. Doors shall open not less than 90 degrees following installation and shall be insulated type where installed in insulated ducts.
- K. Install each fire and combination fire and smoke damper square and true to the building. The installation shall not place pressure on the damper frame, but shall enclose the damper as required by UL555 and UL555S.

3.2 TESTING

- A. After each fire damper, smoke damper and combination fire and smoke damper has been installed and sealed in their prescribed openings and prior to installation of



CMW GENERAL SPECIFICATION
DIVISION 23



Section: 23 33 00 (DUCTWORK ACCESSORIES)

ceilings, Contractor shall, as directed by CMW, activate part or all dampers as required to verify "first-time" closure.

- B. Activation of damper shall be accomplished by manually operating the resettable link, disconnecting the linkage at the fire damper fusible link, and manually operating the fire/smoke damper through the pneumatic or electronic controls as appropriate.
- C. Failure of damper to close properly and smoothly on the first attempt will be cause to replace the entire damper assembly.
- D. Coordinate smoke damper system interlock requirements with the fire alarm system.

- End of Section -



Comments from RA - Dated on 06 April 2023	Naffco reply -07 April 2023	RA response -11 April 2023.	Naffco response
RA Site Team Recommendation	Not Recommended , Very Poor Performance in Etihad Rail projects	<p>1. ER works started without contract and progress reach 8 M without certification initially, meanwhile NAFFCO is suffering with RA to get the payments in ER and all running projects.</p> <p>2. NAFFCO always supporting RA in executing and recommended project even without contract in AUH area and any other area related to AUH team.</p> <p>3. Performance is showing high performance from NAFFCO is FF & ELV meanwhile we have debate technical points for SMS & CBS requirements and it's on going.</p> <p>4. NAFFCO intention is to support RA & Trojan group in all requirements if any further issues to be highlighted pls advise so we can arrange meeting with high level management.</p>	RA Response : Details Poor Performance of Naffco In Etihad Rail will forward via. IOM to HO . moreover refer to naffco monthly evaluation since last years which is shows code-4. Additionally, attached most recent NAFFCO manager attitude and behaviour which we faced in daily basis.
RA Scope of Works	to be complied without single deviation	Noted and complied.	Closed.
Compliance to CMW Specification and Vendor	Not Complied	Noted and complied as per the provided documents.	Closed.
CMW security/gate Pass fees	To be included	To be included based on the CMW charges.	To be included.
Sub-Contractor Exclusions (Not Accepted)	tanks puddle flange and anti vortex plate to be included, pump exhaust piping and insulation to be included	Noted and complied	Closed.
	Design and installation of seismic bracing to be included	We are not doing the same usually, same will be in contractor scope, for installation if required by us we can do subject to cost impact.	To be included under FLS contractor scope.
	Spare part as per CD's requirements to be included	Noted and complied	Closed.
	GI & Flexible conduit to be included	Noted and complied for our scope, pls advise for which systems you are aiming.	All related FLS system such as FA & EM .
	scaffolding /working platform less than 3 mtr to be part of s/c scope	Noted and complied	Closed.
	fire alarm Mimic panel and Repeater to be included	Noted to be added in the offer.	Closed.
	Duct detector to be included , HVAC drawings can be shared.	Details for HVAC are not available, pls provide in order to include the same.	Refer to HVAC Drawings from below link : https://we.tl/t-sNj5J1Vv74
	interfacing of FACP with CD's (24 x 7 - Hassantuk) to be included	Noted and complied, meanwhile Hassantuk Panel to be provided by client as per usual practice.	Closed.
	CMW material vendor to be followed	Noted	To be complied
	cable and accessories form Isolator to CP and Pump to be included	Noted to be added.	To be added.
	point # L at page no.4 not accepted " food , accomadation & transportaion is part of S/C scope	Noted to be added.	To be added.
	CO2 Sensor inside the tunnels to be inculded with related FACP interface with Tunnel Ventilation System	Will be added subject in revised offer.	To be added.
	SMS Fans cable glands to be included .	Usually same be done by electrical contractor, meanwhile if required to be quoted by us, pls advise the detailed scope.	Noted shall be done by RA .
	point # 20 in SMS quote; MSFD is SMS to be inculded	MSFD for HVAC system which is excluded. Anything related to SMS is included in our offer other than electrical works.	Closed.
	point # 21 in SMS quote; seismic , pullout test and load caluculation to be included	Noted as above subject to cost impact.	To be included under FLS contractor scope.

Subcontract Tender Document

LINK-[Fire Fighting 1-Al-Hail 2-Qurayyah](#)

Tender No: 5,847

Project: RA4077-MEP Works - Various Construction in Al Hail and Qu

Drawings

- 1 Fire_Alarm_System__SITE-01_05032023022517.pdf
- 2 Fire_Alarm_System__SITE-02_05032023022548.pdf
- 3 Fire_Fighting_System_SITE-02_05032023022837.pdf
- 4 SMS_SITE-01_05032023022950.pdf
- 5 SMS_SITE-02_05032023023021.pdf
- 6 CBS_SITE-01_05032023023101.pdf
- 7 CBS_SITE-02_05032023023251.pdf
- 8 Fire_Fighting_System_SITE-01_05032023022731.pdf

Responsibility Matrix

- 1 Responsibility Matrix - Responsibility Matrix_05032023024052.pdf

Specification

- 1 Fire__Alarm_Systems_05032023014529.pdf
 - 2 Fire_Fighting_System_05032023014608.pdf
 - 3 CBS_05032023014625.pdf
 - 4 SMS_05032023014638.pdf
-

Specialized Sub-Contractors for Mechanical Systems

Fire Suppression & Wet Chemical Suppression System

Sl no.	
1	NAFFCO
2	SOS International
3	Telelectron
4	Heaven Fire & Safety
5	Concellium Middle East
6	GENENT
7	STARCO
8	Al Shahba

Workshop Equipment Supply & Installation

Sl no.	
1	SEDANA Trading LLC
2	Al Zarouni International Equipment LLC
3	Technical Parts Company (TPC)
4	Energy International
5	Nils and Abbas Trading Company LLC

Medical Gas Equipment Supply & Installation

Sl no.	
1	Gulf Drug LLC
2	Al Mazrouei Medical and Chemical Supplies LLC
3	Modular Concepts Electromechanical LLC

Medical Gas System Third Party Sub-contractors

Sl no.	
1	Altech



NOTE : THE BELOW LIST IS ONLY FOR GUIDANCE CONTRACTOR CAN APPLY FOR EXACT EQUIVALENT FOR CMW APPROVAL
NOTE2 : PROJECT SPECS AND CONTRACT DRA WINGS SHOULD BE FOLLOWD

APPROVED MATERIALS / VENDORS

Sr.#	Material	Manufacturer	Country of Origin
1	AIR RELEASE VALVE	Hawle	Germany
		AVK	Denmark
		Crispin	USA
2	BALL VALVE	AVK	Denmark
		Crane	USA
		Cepex	Spain
3	BTTERFLY VALVE	Singer	Canada
		Hawle	Germany
		AVK	Denmark
4	GATE VALVE	Cepex	Spain
		Hawle	Germany
		Crane	USA
5	SOLENOID / ACTUATED VALVE	AVK	Denmark
		Singer	Canada
		Cepex	Spain



Sr.#	Material	Manufacturer	Country of Origin
	AVK	Denmark	
	Irritrol Systems	USA	
6	CHECK VALVE		
	Crispin	USA	
	Cepex	Spain	
	Hawle	Germany	
	AVK	Denmark	
7	FLOAT VALVE		
	Singer	Canada	
	Hawle	Germany	
	Crane	USA	
8	PRESSURE REDUSING VALVE		
	Hawle	Germany	
	Singer	Canada	
9	NON RETURN VALVE		
	Hawle	Germany	
	Peglar	UK	
10	VALVES		
	Vdl	Holland	
	Flow Flex	UK	
	Grohe	Germany	
11	ANGLE VALVES		
	Grohe	Germany	
	Hawle	Germany	



Sr.#	Material	Manufacturer	Country of Origin
12	DI VALVES 3" AND MORE	Crane AVK	USA Denmark
13	VALVES UP TO 2.5"	Peglar Flow Flex	UK
15	FIRE EXTINGUISHER	Sos Nafco	UAE
16	FIRE FIGHTING CABINET	Bristol	UAE
17	FIRE FIGHTING PUMP SYSTEM JOCKEY , MAIN AND DEIZEL	Patterson Armstrong EURORA	USA Canada USA
18	FIRE HYDRANT	Pont A Mossion Byard	France
20	FITTING FIRE FIGHTING	Shield	UK
22	FLOOR TRAP	Hepworth Zurn Terrain	UAE USA UK



Sr.#	Material	Manufacturer	Country of Origin
23	FLOOR TRAP COVER	SHW Hamada Aqua	Japan Italy
		Ideal S.S	ITALY
24	CABINET	Firex Nafco	UAE
			UAE
25	GREASE TRAP	Bin Mosa HEPworth	UAE UAE
26	GRP LINING	Jims Fiber Glass	
27	GRP PIPE	Future Pipe AD Pipe Extraco Hepworth Gulf Eternet Anabeeb	UAE UAE UAE UAE UAE UAE
28	GRP SECTIONAL TANK (TO BE INSULATED)	Mitsubishi Bridgestone Sungill	Japan Japan KOREA



Sr.#	Material	Manufacturer	Country of Origin
30	GULLY TRAP	Hepworth Terrain (4DG91/4DG92/4DG93)	
31	HAMMER ARRESTOR	Marly Zurn	
32	HDPE PIPES	Hepworth Gebert Union	
33	HOSE REEL	Rasem Ecodora Toro. AG	Italy
35	IRRIGATION COMPONENTS MATERIAL CONTROLLER , SOLONOID VALVES	RAINBIRD IRITROL	USA USA
41	IRRIGATION SUB CONTRACTOR	Emirates Gardens Al Rayum	
45	KITCHEN SINK	Blanco Aqualid Pam	Germany UK



Sr.#	Material	Manufacturer	Country of Origin
46	MH COVER	Self Lock	
	Nff		
	Ducast		UAE
47	OIL SEPERATOR	Haurton	
	Frylit		
48	POLYETHYLENE TANK	Polyemirates	UAE
		Polycon	UAE
		Albassam	UAE
50	PIPE CLAMPS	Flanco	
	PIPE FITTINGS	Van Deland	Holland
51	PIPE SUPPORT	Mupro	
		Hepworth	UAE
52	PPR PIPE	Cosmoplast	UAE
		B.R	Germany
		Novatherm	Germany
55	PRESSURE VESSEL	Baninger	Germany
	PRV	Peglar	UK
56		Aquasystem	
57			



Sr.#	Material	Manufacturer	Country of Origin
59	PVC FITTINGS	Tusmi	Japan
		Comer	Italy
		GF	Germany
		BR	Germany
60	QUICK COUPLING	Rain Bird	USA
		Safe Rain	SPAIN
61	RAIN OUTLET	Zurn	USA
		TERRAIN	UK
		Marly	UK
		G. Ceramic	UAE
63	SANITARY WARE	Roca	Spain
		German Home	
		Lauifex	
		Valery and Boch	
		Lauven	
		Portino	
		Kohller	



Sr.#	Material	Manufacturer	Country of Origin
64	SELF CLOSING MIXER	Ideal Standard	Germany
		Grohe	Germany
		Delabi	France
		PRESTO	France
65	SINK	Blanco	Germany
		Valliant	Germany
66	SOLAR WATER HEATER	Ariston	Italy
		Radiant	
		WOLF	Germany
		HRS	UK
68	SOLVENT CEMENT	Ez-Weld	
		Waterbird	UAE
70	STP EQUIPMENT SUBCONTRACTORS	CORODEX	UAE
		EMCO	UAE
73	SWIMMING POOL SUB CONTRACTOR	AL Khorafi	UAE
		Aqua Italy	Italy
		Hydrotech	UAE
76	VALVE	Peglars	UK



Sr.#	Material	Manufacturer	Country of Origin
	VDL-Holland	Holland	Holland
	Flow Flex	UK	UK
	Pex-708	UK	UK
	Peglar	UK	UK
	Grohe	Germany	Germany
77	VALVE BOX FOR IRRIGATION	Al Wasel Applied Eng.	Saudi Arabia
78	WARNING TAPE	Kangaroo	UAE
80	WATER FILTER	Dulton	UK
		Dulton Minerva	UK
81	WATER HEATER	A-O-Smith Shafuatex Zanussi	Holland Italy Italy
		Sensus	
82	WATER METER	Elster Elesterking Kent	
83	WATER MIXER	Presto Grohe	France Germany



Sr.#	Material	Manufacturer	Country of Origin
84	WATER PUMPS	Delabi	France
		Itt Vogel	USA
		Weir	UK
		Godwin	UK
		KSP	Germany
		Grundfoss	Denmark
85	WATER RECYCLE UNIT	SPP	UK
		Otal	USA
87	STAINLESS STEEL WATER HEATER	pure water	USA
		Santon UK	uk
		Flyight	AUSTRIA
		KSP	Germany
		ABS	irland
		Ksurumi	Japan
88	PUMPS DRAINAGE	Zholner or Homa Germany	Germany
		Banning Kunststoff - Product Gmb	Germany
		Kelin	Italy
90	POLYPROPYLENE PIPES & FITTINGS (PN 20)	Wavin	Germany
		Coestherm	Italy



Sr.#	Material	Manufacturer	Country of Origin
91	FIBER GLASS CYLINDRICAL TANK	Coprax	Italy
		Terrazo	UAE
		Ambush	UAE
92	SWIMMING POOL EQUIPMENT	Al Bassam	UAE
		Astral	Spain
		Nippon	Japan
93	STEEL PIPES	Shield	UK
		Econosto	Holland
		Hepworth	UAE
94	HDPE PIPES	Gebert	UK
		Shield	UK
		Pont A Mossion	France
97	VALVES 3" AND MORE (D.I)	Hawle	AUSTRIA
		Crane	UK
		AVK	Denmark
100	CARBON STEEL PIPE	Flow Flex	UK
		Sumitomo	Japan
		Econosto	Holland



Sr.#	Material	Manufacturer	Country of Origin
101	CHANNEL GRATING	Fudicio	Italy
102	HOT WATER CIRCULATION PUMP	Crane	UK
103	CLAMPS FOR PIPE	WILLO	UK
105	INTERNAL DRAINAGE PIPE	Mefa	
		Terrain	UAE
		Marley	UAE
		Hepworth	UAE



NOTE2 : PROJECT SPECS AND CONTRACT DRA WINGS SHOULD BE FOLLOWD

APPROVED MATERIALS / VENDORS

Sr.#	Material	Manufacturer /Range	Country of origin
1	Water Cooled Centrifugal chiller	Trane Carrier	USA USA
2	Cooling Tower	Macquay BAC Marley Evapco	USA USA USA
3	Air Cooled Chillers	GEA Tower Tech	Europe USA
4	Air Handling Units	Trane Carrier	France KSA/UAE
		SKM Petra	USA/France USA/Mexico UAE
		Macquay	Jordan Italy
		Trane Carrier	Italy/Malaysia KSA/Malaysia
		York SKM Petra	UAE Jordan
		Maker	Italy
		Macquay	Italy



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Approved Materials / Vendors(Architectural and Civil Materials)

Sr.#	Material	Manufacturer /Range	Country of origin
	Euroclima	Europe	U.K./USA
	Flakt wood	UAE	UAE
	Gami	UAE	UAE
	Trosten	UAE	UAE
	Trane	Turkey	
	Carrier	KSA/Malasia	
	York	KSA/UAE	
	SKM	UAE	
	Petra	Jordan	
	Macquay	Italy	
	Maker	Italy	
	Gami	UAE	
	Daikin	Belgium	
	Mitsubishi	Japan/Tailand	
	LG	Korea	
	O-General	Japan/Malasia/Tailand	
	Mitsubishi	Japan/Tailand	
	Rheem	USA	
	Daikin	Malaysia	
	Rheem	USA	
	York	USA	
	Trane	USA	
	SKM	UAE	
	Petra	Jordan	
	GAMI	UAE	
5	Fan Coil Units(Ducted)		
6	VRV System		
7	Split Units		
8	Package Units		



Sr.#	Material	Manufacturer /Range	Country of origin
9	Chilled Water Pump	SPP KSB Grundfoss Amstrong ITT-Bell & Gossett Goulds AURORA Flowserve	UK Germany Germany Italy USA Europe USA Italy
10	Chilled Water Pr.Unit	SPP KSB Grundfoss Amstrong ITT-Vogal Greenheck System Air	UK Germany Germany Italy Austria USA Sweden/Germany
11	Extract Fans	Nu-Air Dynair S&P Ventaxia-Roof units Casels	UK Italy Spain UK Spain
12	VAV/CAV	Twinicity/ELTA Trox Barcol Air Metal Aire Titus	USA UK Holland USA USA



Sr.#	Material	Manufacturer /Range	Country of origin
		EH Price	Canada
13	CCU	Tuttle and Bailey	UK
		Libert	Italy
		Airdale	UK
		Stulze	Germany
		APC	USA/Europe
14	Automatic Control	Stefa Controls	Seimens
		Johnson Control	USA
		Honey Well	USA
		Invensys	UK
		Bry Air	India
		DesertAire	USA
		Dantherm	Denmark
		Munter	USA
15	De-Humidifier	Kiddie Fenewal	USA
		FIKE	USA
16	FM-200	ANSUL	USA
		Fike	USA
		Kiddie Fenewal	USA
17	Wet Chemical Fire Sup.Sys	FIKE	USA
		ANSUL	USA
		Fike	USA
18	Elevators	Mitsubishi	Japan/Tailand
		Thyssen Krupp	Germany
		KONE	Finland



Sr.#	Material	Manufacturer /Range	Country of origin
	EOT Cranes	Schindler	Switzerland
19		FUJI	Japan
		Dopler	Germany
		SWF	Germany
		KONE	Finland
		Demag	Germany
		Abus	Germany
20	Air Separator	ITT	USA
		TACO	USA
		GE	USA
		Allan Bradley	USA
21	PLC	Modicon	France
		Siemens	Germany
		ABB	Germany
		Wika	USA
		Wekseler	UAS
		McDaniel	USA
		H & B	USA
		Wika	USA
		Wekseler	USA
22	Temp. Guage	McDaniel	USA
		Rosemount	USA
		Barton	USA
		Sen Sit	USA
23	Pressure Guage		



Sr.#	Material	Manufacturer /Range	Country of origin
24	Flow Switch	ITT Neodyn SOR Inc Platon	USA USA France/UK
25	Pressure Switch	Rosemount E & H	USA Swiss
26	Temperature Transmitter	Rosemount E & H Brealy	USA USA Germany
27	Pressure Transmitter	Yokogawa SenSit Dieterich	Japan UK Germany
28	Level Transmitter	Miltronics ITT Barton Penberthy Magnetrol Nulectrohms	Germany USA USA USA UK
29	Magnetic Flow Meter	Rosemount Platon Yokogawa Aaliant E & H	USA UK Japan USA Swiss



Sr.#	Material	Manufacturer /Range	Country of origin
	Danfoss		Denmark
	E & H		Swiss
	Hoofer		USA
30	BTU Meter/Flow Computer	Data Industrial	USA
	Contrec		UK
	E & H		Swiss
	E & H		Swiss
	Hach		Germany
31	Chemical Testing Equipment	Horiba	USA
	Alfa laval		Sweden
	HRS funke		Germany
	Sondex		Denmark
	ITT		USA
32	HEX		
	Nippon		Japan
	Nishin		Japan
	Sumitomo		Japan
	Nippon		Japan
	Kawazaki		Japan
33	Sheet Metal for duct work		
34	Black steel pipes for CHW	Econostov/Vanluawan Saudi Steel Tata Steel	Holland,Ukraine KSA India
35	Steel pipe fittings	Neffit Crane Benkan	Holland UK Japan



Sr.#	Material	Manufacturer /Range	Country of origin
36	Pr-Insulated CHW pipes (Steel Core Pipe)	EPPI Perma Pipe Elipse	UAE UAE UAE
37	Pre-Insulated CHW pipes (HDPE Core pipe)	EPPI Perma Pipe	UAE UAE
38	Fibre glass Insulation (Duct)	Kimmco Afico Ideal	Kuwait KSA USA
39	Fibre glass Insulation (Pipe)	Kimmco Afico Ideal	Kuwait KSA USA
40	Acoustic Lining	Kimmco Afico Ideal	Kuwait KSA USA
41	Duct/Pipe Insulation	Thermobrake Muller Brass	Istrelia USA
42	Copper pipes & fittings		
43	Elastomeric foam insulation	Aeroflex Gulfoflex Armaflex	Europe UAE Italy
44	Coatings & Adhesives	Foster	USA



Sr.#	Material	Manufacturer /Range	Country of origin
		Ideal	UK
45	Rubber Inserts	Diamond MER	UAE UAE
46	Pipe supports & Hangers	Diamond Weico Flamco Grinnel Mupro	UAE UAE India USA W. Europe
47	Aluminium Tapes	Erico Anvil Excell	USA USA USA
48	Flexible duct connectors	Ideal Duradyne K Flex	UK USA UK/USA
49	VCD	Air master Gmamco Technalco Beta Prime	UAE UAE UAE UAE
50	FD	KBE Pottorff Ruskin Air master	Jordan USA USA UAE



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Approved Materials / Vendors(Architectural and Civil Materials)

Sr.#	Material	Manufacturer /Range	Country of origin
51	AD(Access doors)	Gmamco	UAE
		Technalco	UAE
		Beta	UAE
		Prime	UAE
		KBE	Jordan
		Pottoroff	USA
		Air master	UAE
		Gmamco	UAE
		Technalco	UAE
		Beta	UAE
52	Air outlets (Grills& Diffusers)	Prime	UAE
		KBE	Jordan
		Air master	UAE
		Technalco	UAE
		Beta	UAE
		Trox	UK/Malaysia
		EH Price	Canada
		Titus	USA/Europe
		Supaflex	UAE
		ATCO	USA
53	Flexible duct	Totaline	USA
		Kinetics	USA
54	Vibration Isolators	Vimco	USA
55	Guages & Thermometers	Weiss	USA



Sr.#	Material	Manufacturer /Range	Country of origin
	Hunter	Germany	Germany
	WICA	Germany	Germany
	Crane	USA	USA
56	AAV(Automatic Air Vent)	Watts	USA
		Hattersly	UK
		Crane	USA
		Nippon	Japan
		Neffit	Holland
		Benken	Holland
		Neffit	Holland
57	Butt weld Fittings	BIS	Tailand
		Xpelair	UK
		KDK	Japan
		Vortice	UK
58	MI Fittings	Hattersly	UK
		Crane	UK
		Econosto	Holland
59	Window /Wall mounted fans	Watts	UK
		Oventrop	UK
		Pegler	UK
60	Valves		



Sr.#	Material	Manufacturer /Range	Country of origin
61	Strainers	Tecofi Flowcon Bray Tour and Anderson Hattersly Crane Econosto Flowcon	France Netherland USA USA UK UK Holland Netherland
62	Control Valves	Johnson Control Honey well Seimens Invensys Bin Air	USA USA/Europe Germany/Swiss France/UK Germany
63	Silencers	Safid ATAI Gulf Acoustics Acoustic Air Technology Gmamco	KSA/Finland UAE UAE UAE UK
64	Chemical Treatment	Houseman Hegro Grace Dearbon Culligan Metito Waterbird Cool Teek Veolia Water Systems	UK USA USA UAE UAE USA/UAE Europe/France



NOTE2 : PROJECT SPECS AND CONTRACT DRA WINGS SHOULD BE FOLLOWD

APPROVED MATERIALS / VENDORS FOR PLUMBING

Sr.#	Material	Manufacturer	Country of Origin
1	WATER PUMPS - MAIN	KSB	Germany
		Thyssen	Germany
		Clyde Union Limited (Formerly Clyde Pumps) TM.P.S.P.A. Termomeccanica Pome	Glasgow, United Kingdom Italy
		Ingersoll Dresser Pumps	Hamburg, Germany
		Ebara Corporation	Japan
		Torishima Pumps MFG Co. LTD	Japan
		Alstom Fluides & Mecaniques (France)	France
		Ingersoll Dresser Pumps	Gateshead, United kingdom
		Sulzer	D-76646 Bruchsal, Germany
		Ingersoll Dresser Pumps	Annandale, NJ 08801 USA, Italy
2	PUMPS - DOMESTIC WATER	Hitachi Plant Technologies	Tokyo, Japan
		Andritz	Graz, Australia
2	PUMPS - DOMESTIC WATER	KSB	Germany
		Ingersoll Dresser Pumps	Hamburg, Germany
		Grundfos	Martin Bachs VEJ 3, Denmark



Sr.#	Material	Manufacturer	Country of Origin
3	Ingersoll Dresser Pumps	Gateshead, United Kingdom	Gateshead, United Kingdom
	R.B. Pump	Baxley, GA, United States	Baxley, GA, United States
	Nyhuis Fire Protection B.V	Winterswijk, Netherlands	Winterswijk, Netherlands
	Ingersoll Dresser Pumps	Hamburg, Germany	Hamburg, Germany
	Goodwin International Ltd	Staffordshire, United Kingdom	Staffordshire, United Kingdom
	Ingersoll Dresser Pumps	Gateshead, United Kingdom	Gateshead, United Kingdom
4	Patterson Pump Company	Georgia, United States	Georgia, United States
	S.A. Armstrong Limited	Toronto, Ontario, Canada	Toronto, Ontario, Canada
	KSB	Germany	Germany
	Pleuger Worthington GmbH / Ingersoll Dresser	Hamburg, Germany	Hamburg, Germany
	Lowara	Italy	Italy
	Grundfos	Martin Bachs VEJ 3, Denmark	Martin Bachs VEJ 3, Denmark
5	KSB	Germany	Germany
	Aurora Pump	United States	United States
	Grundfos	Martin Bachs VEJ 3, Denmark	Martin Bachs VEJ 3, Denmark
	Biral A.G	Switzerland	Switzerland
6	Vioght	89510 Heidenheim, Germany	89510 Heidenheim, Germany
	AIR BLOWERS & FAN - ID/FD	United Kingdom	United Kingdom
	Twin City Fan & Blower	United States	United States



Sr.#	Material	Manufacturer	Country of Origin
	Penn Ventilation Inc		United States
	System Air	CO4 SAR Colchester, Essex, United Kingdom	Skinnskatterberg, Sweden
	Woods Air Movement		
	Hepworth P.M.E. (L.L.C), Dubai		Dubai, United Arab Emirates
	Gulf Eternit Industries Company LTD.		Dubai, United Arab Emirates
	Cosmoplast Industrial Co. W.L.L		Sharjah, United Arab Emirates
	Union Pipe Industry - LLC		Abu Dhabi, United Arab Emirates
	Hobas Emirates Company LLC		Biniyas, United Arab Emirates
	Simplast SPA		Italy
	Simplast SPA		Italy
	Durapipe - S & LP		Cannock Staffordshire, United kingdom
	Al moherbie Thermoplast		United Arab Emirates
	Emirates Pipe Factory		Abu Dhabi, United Arab Emirates
	Amiantit Oman		Next to National Gas Co. Russayl Sul, Oman
	Georg Fischer Piping System Ltd		Schaffhausen/Switzer, Switzerland
	Al Dhafra Pipes Factory LLC		Abu Dhabi, United Arab Emirates
	Inter Pipe Factory		Abu Dhabi, United Arab Emirates
	Alpha Emirates Plastic Pipes & Fitting Factory		Dubai, United Arab Emirates
7	PIPES - HDPE/PE		Al Ain, United Arab Emirates



Sr.#	Material	Manufacturer	Country of Origin
8	PIPE FITTINGS - HDPE/PE	Liansu Group Company Limited	Guangdong, China
		Agru Kunststofftechnik GMBH	Bad Hall, Austria
		Plastitalia SPA	Brolo (ME), Italy
		Liansu Group Company Limited	Guangdong, China
		United Staes Pipe & Foundry Co.	United States
		American Cast Iron Pipe Co. (ACIPCO)	Birmingham Alabama, United States
		Kubota	Tokyo, Japan
		Von Roll	Switzerland
		Duker	Deutschland, Germany
		Saudi Arabian Ductile Iron Pipes Co. (SADIP)	Dammam, Saudi Arabia
		Stanton & Stavely	UK, United Kingdom
		Duktus (Formerly Buderus Heiztechnik)	Sophien Stabe, Germany
		Electrosteel Castings Limited	Kolkata, India
		Tyco Water PYT LTD	New South Wales, Australia
		Metalska Industrija Varazdin (MIV)	Croatia
		Xinxing Ductile Iron Pipes Co. Ltd. - Handan	Handan, China
		Xinxing Ductile Iron Pipes Co. Ltd. - Toujiang	Toujiang, China
		Saint - Gobain Maanshan Foundry Co. Ltd.	Maanshan, China
		Saint - Gobain Thyssen	Germany



Sr.#	Material	Manufacturer	Country of Origin
10	Ludwig Frischhut GMBH & Co. UG	Pfarrkirchen, Germany	
	United Staes Pipe & Foundry Co.	United States	
	American Cast Iron Pipe Co. (ACIPCO)	Birmingham Alabama, United States	
	Kubota	Tokyo, Japan	
	Von Roll	Switzerland	
	Saudi Arabian Ductile Iron Pipes Co. (SADIP)	Dammam, Saudi Arabia	
	Stanton & Stavely	UK, United Kingdom	
	Xinxing Ductile Iron Pipes Co. Ltd. - Hebel	Beijing, China	
	KOREA CAST IRON PIPE IND (KCIPI)	Pusan, Korea, Republic of	
	Duktus (Formerly Buderus Heiztechnik)	Sophien Stabe, Germany	
PIPES: DUCTILE IRON		Kolkata, India	
Electrosteel Castings Limited		New South Wales, Australia	
Tyco Water PYT LTD		Maanshan, China	
Saint - Gobain Pipelines Co. Ltd. (Maanshan Plant)		Xuzhou, China	
Saint - Gobain Xuzhou Pipelines		Germany	
Saint - Gobain Thyssen		LIPETSK, Russian Federation	
SVOBODNY SOKOL		Kolkata, India	
TATA METALIKS KUBOLTA PIPESLIMITED (TMKPL).			



Sr.#	Material	Manufacturer	Country of Origin
11	PIPES AND FITTINGS - GRP/FRP/GRE	ENGTEX DUCTILKE PIPE INDUSTRY SDN. BHD	PAHANG, malaysian
		L L LTD.	Abu Dhabi, United Arab Emirates
		ABU DHABI PIPE FACTORY - WLL	Dubai, United Arab Emirates
		ABU DHABI, United Arab Emirates	Abu Dhabi, United Arab Emirates
		ANABEEB PIPE MANUFACTURING FACTORIES	Abu Dhabi, United Arab Emirates
		Hobas Emirates Company LLC	Biniyas, United Arab Emirates
		ADVANCED COMPOSITES FZC	Sharjah, United Arab Emirates
		Emirates Pipe Factory	Abu Dhabi, United Arab Emirates
		INTERPLAST CO LTD ABU DHABI RANCHI 2	Abu Dhabi, United Arab Emirates
		AMERICAN CAST IRON PIPE CO.(ACIPCO)	Birmingham, Alabama, United States
12	PIPES - CARBON STEEL	Thyssen	Germany
		Fuchs Rohr	D 57022 Siegen 1 Germany
		Nippon Steel Corp.	GTEMACHI, Japan
		Mannesmann Demag AG	Germany
		Sider Forge S.R.L	Italy
		Sumitomo Corporation	Tokyo, Japan
		Tyco Water PYT LTD	New South Wales, Australia



Sr.#	Material	Manufacturer	Country of Origin
	National Pipe Company LTD	Al Khobar, Saudi Arabia	
GTS		France	
PANYU CHU KONG STEEL PIPE CO. LTD. (PCK)		GUANGZHOU, China	
KUWAIT PIPE INDUSTRIES & OIL SERVICES CO.		Safat, Kuwait	
PSL FZE		United Arab Emirates	
SEAH STEEL CORPORATION		KOREA ,Korea, Republic of	
GROUP FIVE PIPE SAUDI		DAMMAM, Saudi Arabia	
NKK CORPORATION		TOKYO 100-8202, Japan	
PIPES - CARBON STEEL FOR COMPOUND	HYUNDAIRB CO., LTD., KUWAIT PIPE INDUSTRIES & OIL SERVICES CO.	ULSAN ,Korea, Republic of Safat, Kuwait	
13			
	Hepworth P.M.E. (L.L.C), Dubai	Dubai, United Arab Emirates	
	Cosmoplast Industrial Co. W.L.L	Sharjah, United Arab Emirates	
	BIN BROOK PLASTIC INDUSTRIES	Al Ain, United Arab Emirates	
	EXCELLENT PIPES AND COMPANY LL..C	Abu Dhabi, United Arab Emirates	
	BIN MANSOUR PLASTIC FACTORY	Abu Dhabi, United Arab Emirates	
	ANABEEB PIPE MANUFACTURING FACTORIES	Abu Dhabi, United Arab Emirates	
14	PIPES & FITTINGS - PVC/UPVC	Georg Fischer Piping System Ltd	Schaffhausen/Switzer, Switzerland
15	PIPES SUPPORT/HANGERS	AMBUSH FIBRE WORKS- L L C	Abu Dhabi, United Arab Emirates



Sr.#	Material	Manufacturer	Country of Origin
16	PIPES SUPPORT/HANGERS	KUWAIT PIPE INDUSTRIES & OIL SERVICES CO. Bredero Shaw PSL FZE	Safat, Kuwait Ras Al Khaimah, United Arab Emirates United Arab Emirates
17	PIPES - EPOXY INTERNAL COATINGS	GLOBAL ANTI-CORROSION TECHNIQUECO. LTD. (GLOBETECH) Bredero Shaw PSL FZE	Jubail Industrial City, Saudi Arabia Ras Al Khaimah, United Arab Emirates United Arab Emirates
18	DUCTILE IRON PIPES TAPE WRAPPING	HENKEL POLYBIT INDUSTRIES LTD PREMIER COATINGS LTD LONGWRAP SERVIWRAP	Jubail Industrial City, Saudi Arabia United Arab Emirates United Kingdom United Kingdom Berkshire, United Kingdom
19	DETECTABLE WARNING TAPE	KANGAROO PLASTICS MIDDLE EAST- L L C AL SAMIR PLASTIC FACTORY LLC. Boddington	Abu Dhabi, United Arab Emirates Sharjah, United Arab Emirates United Kingdom
19	DETECTABLE WARNING TAPE	ABU DHABI CARNATION METALINDUSTRIES ESTABLISHMENT Al Shamsi Ferrous and non Ferrous Manufacturing (SICAST)	Abu Dhabi, United Arab Emirates Dubai, United Arab Emirates



Sr.#	Material	Manufacturer	Country of Origin
	ARAX INTERNATIONAL TURNING & BLACKSMITH CENTRE	Abu Dhabi, United Arab Emirates	
	AL TADHAMON GLASS & ALLUMEST.	Abu Dhabi, United Arab Emirates	
	GRANADA METAL CASTING	Abu Dhabi, United Arab Emirates	
	Al Qandeel	United Arab Emirates	
	ZEFYR CONSULTANTS LTD	WORCESTERSHIRE, United Kingdom	
20	MANHOLE COVERS CAST IRON	Carnation Industries Ltd	Kolkata, India
	Viking Johnson	United Kingdom	
	Talbot Under Pressure Engineering(UPE)	United Kingdom	
	GLYNWED PIPE SYSTEMS (HELDEN)	HITCHIN, HERFORDSHIRE, United Kingdom	
21	MANHOLE COVERS CAST IRON	Klamflex Pipe Couplings (Pty) Ltd. UNIJOINT	South Africa Netherlands
	Piping Technologies	France	
	Metalska Industrija Varazdin (MIV)	Croatia	
	Al Dhafra Pipes Factory LLC	Abu Dhabi, United Arab Emirates	
21	PILES & TITINGS. STEEL REINFORCED THERMOPLASTIC	ADVANCED PIPES & CAST COMPANY W.L.L	Abu Dhabi, United Arab Emirates
22	PIPES & FITTINGS: REINFORCED CONCRETE	Bin Harmal Cement Products Factory	Al Ain, United Arab Emirates
23	PIPES: EXPANSION JOINTS/BELLOW	N. MINIKIN & SONS LIMITED Proco	NORTH YORKSHIRE, United Kingdom United States



Sr.#	Material	Manufacturer	Country of Origin
	KE BURGMANN A/S	Vejen, Denmark	
24	CARBON STEEL PIPE FITTINGS	WILLBRANDT TK CORPORATION	D-22525 Hamburg, Germany Korea, Republic of
25	PIPES: FABRICATED	FABTECH INTERNATIONAL LTD. Talbot Under Pressure Engineering(UPE) PEGLER LIMITED EBCO	Dubai, United Arab Emirates United Kingdom United Kingdom United Kingdom
26	HOUSE WATER CONNECTION FITTINGS	SEPPIEFRICKE WATERFIT BREON BALLOFIX	Germany United Kingdom Denmark
	FONDERIES OHANNES KASSARDJIAN S.A.L (OK FOUNDRIES)		Beirut, Lebanon
	Liansu Group Comppny Limited	GUANGDONG, China	
	Meinecke	Germany	
27	PIPES: STRAINERS & TRAPS	Mueller Flow Technologies Krombach Armaturen Kaysafe Engineering LTD.	United States Germany United Kingdom
	VERM		Netherlands
28	PIPES: STRAINERS & TRAPS	GLOBAL ANTI-CORROSION TECHNIQUECO. LTD. (GLOBETECH)	Jubail Industrial City, Saudi Arabia
29	DUCTILE IRON MANHOLE COVERS & FRAMES	ABU DHABI CARNATION METAL INDUSTRIES ESTABLISHMENT Ducast Factory LLC Water	Abu Dhabi, United Arab Emirates Dubai, United Arab Emirates



Sr.#	Material	Manufacturer	Country of Origin
	GLYNWED PIPESYSTEMS (HELDEN)	HITCHIN, HERFORDSHIRE, UniteKingdom	
	Norfond(Norico)	France	
	Carnation Industries Ltd	Kolkata, India	
	Canusa systems Ltd	ONTARIO, Canada	
30	PIPES: HEAT SHRINK SLEEVES	Vag Armaturen GmbH Glenfield Valves Ltd BELGICAST INTERNATIONAL SL. Total Technical Valves(TTV) Internacional S.L St+S Armaturen Technik GmbH Beyard Duker	MANNHEIM, Germany KILMARNOCK, United Kingdom MUNGUITA, Spain MADRID, Spain 39110 MAGDEBURG, Germany France Deutschland, Germany
31	VALVES - GATE	BIZONVEJ 1, SKOVBY, Denmanrk Erhard GmbH & Co PREMIER VALVES (PTY). Ltd METALSKA INDUSTRIJA VARAZDIN (MIV) F.A.F VANASANAYI VE TICARET LIMITED SIRKETI KSB Italia	Germany RANDHART SA, South Africa Croatia Ankara, Turkey Frankenthal, Italy
		Vag Armaturen GmbH Glenfield Valves Ltd Total Technical Valves(TTV) Internacional S.L	MANNHEIM, Germany KILMARNOCK, United Kingdom MADRID, Spain

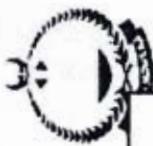


Sr.#	Material	Manufacturer	Country of Origin
32	VALVES - GATE	S+S Armaturen Technik GmbH Grove	39110 MAGDEBURG, Germany Italy
	Beyard		France
	Duker		Deutschland, Germany
	AVK		BIZONVEJ 1, SKOVBY, Denmark
	Erhard GmbH & Co		Germany
	Keystone		Breda, Netherlands
	PREMIER VALVES (PTY). Ltd		RANDHART SA, South Africa
	Advance Valves		Noida, India
	Metalska Industrija Varazdin (MIV)		Croatia
33	VALVES - BUTTERFLY	Saint - Gobain Condontte	Italy
	Valvitalia		IT, Italy
	Borsig		Germany
	Naval Oy		Finland
	Valvitalia		Italy
	Vag Armaturen GmbH		Mannheim, Germany
	Grove		Italy
	AVK		BIZONVEJ 1, SKOVBY, Denmark
	Mannesmann Demag AG		Germany
	Erhard GmbH & Co		Germany
	PREMIER VALVES (PTY). Ltd		RANDHART SA, South Africa
	F.A.F VANASANAYIVE TICARET LIMITED SIRKETI		Ankara, Turkey
36	VALVES - AIR	Vag Armaturen GmbH	Mannheim, Germany

Sr.#	Material	Manufacturer	Country of Origin
	Glenfield Valves Ltd	KILMARNOCK, United Kingdom	
	S+S Armaturen Technik GmBH	39110 MAGDEBURG, Germany	
Beyard		France	
AVK		BIZONVEJ 1, SKOVBY, Denmark	
Mulric Hydro Projects (Pty) Ltd/ Vent-O-Mat		South Africa	
Erhard GmbH & Co		Germany	
PREMIER VALVES (PTY). Ltd	RANDHART SA, South Africa		
Metalska Industrija Varazdin (MIV)	Croatia		
	Henry Technology	Planstra, Germany	
	F.A.F VANASANAYI VE TICARET LIMITED SIRKETI	Ankara, Turkey	
37	VALVES: SPECIAL/NON STANDARD BALL VALVES		
38	VALVES: GLOBE		Ankara, Turkey
39	VALVES: SLIDE / PENSTOCKS	KWT Group Penstocks	Biddinghuizen, Netherlands
40	VALVES: ALTITUDE	Glenfield Valves Ltd	Heidenheim, Germany
41	VALVES: NON RETURN	Glenfield Valves Ltd S+S Armaturen Technik GmBH	KILMARNOCK, United Kingdom 39110 MAGDEBURG, Germany
		Giant Reinforced Plastic Industries. Ltd. (GRP Indu	Sharjah, United Arab Emirates
		Gulf Polymers Company Limited LLC	Abu Dhabi, United Arab Emirates
	AMBUSH FIBRE WORKS- L L C		Abu Dhabi, United Arab Emirates



Sr.#	Material	Manufacturer	Country of Origin
42	VALVES: NON RETURN	ANABEEB PIPE MANUFACTURING FACTORIES Extra Co. Fibre Glass & Prefab Houses LLC - Sharjah	Abu Dhabi, United Arab Emirates
	Nael Cement Products	Mitsubishi	Sharjah, United Arab Emirates
	Advanced Composites FZC	Bridgestone	Al Ain, United Arab Emirates
	AMBUSH FIBRE WORKS- L L C	AMBUSH FIBRE WORKS- L L C	Japan
43	GATES, STEEL DOORS STEEL	Gulf Precast Concrete Company - WLL Abu Dhabi Precast Nael Cement Products Pioneer Precast Concrete LLC	Abu Dhabi, United Arab Emirates
		RAK Precast FZC	Al Ain, United Arab Emirates
		Exeed Aswar LLC	Abu Dhabi, United Arab Emirates
		Exeed Precast LLC	Ras Al Khaimah, United Arab Emirates
44	PRECAST CONCRETE/SECTIONS/ MODULES	Dubai Precast LLC - Dubai Factory Xtramix International Precast LLC United Precast Concrete Abu Dhabi LLC Emarat Europe Fast Building Technology Systems Factory	Dubai, United Arab Emirates
45	GALVANIZATION FACTORIES	Technical Metal Industrial Company - WLL	Abu Dhabi, United Arab Emirates



Sr.#	Material	Manufacturer	Country of Origin
46	FIRE HYDRANTS, HOSES, NOZZLES & COUPLING	Glenfield Valves Ltd Beyard Emirates Fire Fighting Equipments (FIREX) Emirates Fire Fighting Equipments (FIREX) Bristol Fire Engineering AVK-HM France (Formerlysmithm) AVK	KILMARNOCK, United Kingdom France Sharjah, United Arab Emirates Sharjah, United Arab Emirates Dubai, United Arab Emirates Blois, France GB-NN4 7ZU Northampton, United Kingdom
47	AUTOMATIC CO2/DELUGE/SPRINKL ER/FM200 SYSTEMS	TYCO FIRE & INTEGRATED SOLUTIONS(UK) LTD.(FORMELYWormald) Minimax GmbH Chemetron Fire Systems Fire Protection Systems Kidde Fire Protection United Industrial Group A.O Smith Electric Motors FRANKLIN HODGE IND.LTD GALGLASS PEABODY TEC TANK CST Industries UK Vulcan Tanks Ltd NATIONAL FIRE MANUFACTURINGCO.(NAFFCO)	MANCHESTER , United Kingdom Bad Oldesloe, Germany Matteson, United States Blue Spring Mo 64015, United States United Kingdom HANT VALLEY, United States United States Hereford, United Kingdom SOUTH YORKSHIRE, UnitedKingdom United States DERBYSHIRE, United States Jebel Ali, United Arab Emirates
48	FIRE WATER TANKS	TYCO FIRE & INTEGRATED SOLUTIONS(UK) LTD.(FORMELYWormald)	MANCHESTER , United Kingdom

Sr.#	Material	Manufacturer	Country of Origin
49	FIRE EXTINGUISHERS	Saudi Arabian Fertilizer Co.(Saftco) Minimax GmbH Angus Fire Armour Ltd Kidde Fire Protection Emirates Fire Fighting Equipments (FIREX) Emirates Fire Fighting Equipments (FIREX) Bristol Fire Engineering	RIYADH, Saudi Arabia Bad Oldesloe, Germany OXFORDSHIRE, Germany United Kingdom Sharjah, United Arab Emirates Sharjah, United Arab Emirates Dubai, United Arab Emirates
50	FOAM PROTECTION SYSTEM	TYCO FIRE & INTEGRATED SOLUTIONS(UK) LTD.(FORMELY Wormald) Fire Protection Systems National Foam Inc. Kidde Fire Protection Emirates Fire Fighting Equipments (FIREX) Emirates Fire Fighting Equipments (FIREX)	MANCHESTER , United Kingdom Blue Spring Mo 64015, United States Blue Spring Mo 64015, United States United Kingdom Sharjah, United Arab Emirates Sharjah, United Arab Emirates
51	FIBERGLASS PRODUCTS	AMBUSH FIBRE WORKS- L L C Fiber Flex Factory Alldos Eichler GMBH	Abu Dhabi, United Arab Emirates Abu Dhabi, United Arab Emirates Pfinztal (Sollingen), Germany
52	CHLORINATION PLANTS MATERIALS INTERVAL LINING	AMBUSH FIBRE WORKS- L L C	Abu Dhabi, United Arab Emirates
53	FOR PORTABLE WATERED STORACE	Pac Technologies LLC Corrotech Construction Chemicals Envirocon Construction Products Factory LLC	Dubai, United Arab Emirates Dubai, United Arab Emirates Abu Dhabi, United Arab Emirates
54	CHEMICALS - CONSTRUCTION	Siemens AG	Munich, Germany
55	MOTORS: PUMPS		

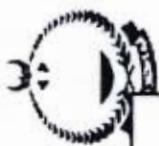
Sr.#	Material	Manufacturer	Country of Origin
	SCHNEIDER ELECTRIC ENERGY DEUTSCHLAND (FORMLY AREVA)		Germany
	ABB OY	Vaasa, Finland	
	ABB	Postfa, Germany	
	ABB	Ludvika, Sweden	
	ASI-ROBICON	Milano, Italy	
	SCHNEIDER ELECTRIC ENERGY	Paris La Defense, France	
	SIEMENS FLOW INSTRUMENTSAS (FORMERLY DANFOSS)	2750 Ballerup, Denmark	
	ABB	Postfa, Germany	
	SEVERN TRENT SERVICES (Formerly Fusion Meter Ltd)	Chesterfield, United Kingdom	
	ITRON FRANCE-MACON CEDEX FACTORY (FORMERLY ACTARIS)	Macon Cedex, France	
	ENDRESS+HAUSER	France	
	KROHNE	Postbus 110 3300 AC Dordrecht, Netherland	
	CIRCLE RING NETWORK Water(CRN)	4153 Reinach, Switzerland	
	Elster Metering Ltd.		
	SOCAM	Selangor Darul Ehsan, Malaysia	
	CONSUMER CONNECTION WATER METER	Luton, Bedfordshire, United Kingdom	
		France	
59	ELECTRO-MAGNETIC FLOW METER		
60	INVENSYS METERING SYSTEMS	Chesterfield, united kingdom	
		67063 LUDWIGSHAFEN, Germany	

Sr.#	Material	Manufacturer	Country of Origin
62	METERING & PRESSURE REACTION SKIDS	Smith Meter Inc Daniel Measurement & Control Inc. EMERSON ELECTRIC CO Daniel Industries Inc. EMERSON ELECTRIC CO	United States United States United States United Kingdom London W1U 6EQ, United Kingdom
63	LEVEL INSTRUMENTS	WHEESSOE VAREC E & H SOLATRON MOBREY	United Kingdom Germany B.P.21, France
64	PRESSURE, DIFFERENTIAL AND TEMPERATURE	WIKA ALEXANDER WEIGNAD GmbH& CO.	Wuttemburg, Germany
65	ODOUR - ACTIVATED AND OTHER ADSORPTION MEDIA	CHEMVIRON CARBON NORIT NEDERLAND B.V. CPL CARBON LINK CARBON CLOTH INTERNATIONAL(CCI) WAB	Belgium Holland, Netherlands Wigan, Lancashire, WN3 5HE, United Kingdom United Kingdom Germany
66	ODOUR - CONTROL SYSTEM, SCURBBERS & CHEMICAL TECHNOLOGIES	Degremont US Filter ENDRESS+HAUSER CSO TECHNIK LTD. ACWA AIR CPL ENVIRONMENTAL ENGINEERING	France United States 4153 Reinach, Switzerland Edenbridge, Kent, United Kingdom United Kingdom United Kingdom



Sr.#	Material	Manufacturer	Country of Origin
	ENVICON	ENVICON	Germany
	ERG	ERG	United kingdom
	MUSOL LIMITED	MUSOL LIMITED	United kingdom
	US Filter	US Filter	Germany
	VEOLIA	VEOLIA	France
	Vag Armaturen GmBH	Vag Armaturen GmBH	MANNHEIM, Germany
	S+S Armaturen Technik GmBH	S+S Armaturen Technik GmBH	39110 MAGDEBURG, Germany
	Beyard	Beyard	France
	Nencini Spa	Nencini Spa	Italy
	Mannesmann Demag AG	Mannesmann Demag AG	Germany
67	VALVES - CONTROL	Erhard GmbH & Co	Germany
		Cla-Val Automatic Control Valves	Switzerland
		Metalska Industrija Varazdin (MIV)	Croatia
		Saint - Gobain Condontte	Italy
	AUMA	AUMA	Germany
68	ACTUATORS (ELECTRIC)	Rotork Controls	United kingdom
		Ocean Rubber Factory LLC	Abu Dhabi, United Arab Emirates
		AMBUSH FIBRE GLASS WORKS- L L C	Abu Dhabi, United Arab Emirates
		GULF SPECIALIZED MECHANICAL & ENGINEERING	Abu Dhabi, United Arab Emirates
		SERVICOMPANIES - L L C	Abu Dhabi, United Arab Emirates
69	SURGE VESSELS	FABTECH INTERNATIONAL LTD.	Dubai, United Arab Emirates
		QUANTUM ENGINEERING DEVELOPMENTS(Q.E.D.)	Worchester, United Kingdom

Sr.#	Material	Manufacturer	Country of Origin
70	PNEUMATIC VESSELS (GAS/FLUID)	SPC, LTD	Jeonbuk, Korea, Republic of
71	PUMPS - VERTICAL TURBINE - SEWERAGE APPLICATION	Floway Pumps (Weir Floway Inc) Turbine Services Ltd. Atlantic Wood Industries Inc INGERSOLL DRESSER Water SPECK PUMPS WALLWIN PUMP	Fresco, CA, United States United States United States United States South Africa United Kingdom Germany
72	PUMPS - SELF PRIMING - SEWERAGE APPLICATION	VANTON ABEL GmbH & Co.KG AJG WATERS EMS INDUSTRIES	United States Berkshire, United Kingdom United Kingdom United States
73	PUMPS - RAM - SEWERAGE APPLICATION	ENERGY PUMPS FILPUMPS JOHN BLAKE Alfa Laval	United Kingdom United Kingdom United Kingdom United Kingdom 0, Sweden



Sr.#	Material	Manufacturer	Country of Origin
74	PUMPS - DIAPHRAM - SEWERAGE APPLICATION	GRUNDFOS EIMCO WATER TECHNOLOGIES LLC T-T PUMPS BIBUS NEW HADEN PUMPS SHURFLO EUROPE VERDER	Martin Bachs VEJ 3, Denmark Austin (TEXAS) 78758, United States United Kingdom United Kingdom United States Germany
75	PUMPS - CHEMICAL DOSING - SEWERAGE APPLICATION	AXFLOW COLE PARMER GEE GRUNDFOS INDUSTRIAL SALUTATIONS MACKLEY PUMPS PROMINENT FLUID CONTROL SERA DOSING UK LTD SIEMENS WATER TECHNOLOGIES	United Kingdom Germany United Kingdom United Kingdom United Kingdom United Kingdom Germany
		Baldor Toshiba Corporation Water Leroy Somer Hawker Siddeley Switchgear,Ltd	United States Tokyo, Japan Angoueme Cedex, France Blockwood, South Wales NP 12 21XH, United Kingdom
		Mitsubishi Loher ABB OY ABB	Japan Germany Vaasa, Finland Ludvika, Sweden

Sr.#	Material	Manufacturer	Country of Origin
76	SEWERAGE - MOTORS PUMP	Fuji Electric Corp. AEG White Westing House ASI-ROBICON ABB INDUSTRIE SNCWater GENERAL ELECTRIC INTERNATIONAL FLYGT (ITT GROUP) BROOK HANSEN HOWELL'S STANWAY NORD SCHNEIDER ELECTRIC ENERGY	Japan Germany United States Milano, Italy Chassieu, France Louisville, United States Germany Germany United Kingdom Germany Paris La Defense, France Germany Helsinki, Finland United States United Kingdom Germany Glasgow, United Kingdom Tokyo, Japan Switzerland Italy Hamburg, Germany Hamburg, Germany Italy
	KSB GRUNDFOS - SARLIN Cornell Biwater Industries Thyssen CLYDE UNION LIMITED (FORMER CLYDE PUMPS) KUBOTA Sulzer Burckhardt T.M.P. S.P.A. Temomeccanica Pome Ritz Messwandler Ingersoll Dresser Pumps Lowara		



Sr.#	Material	Manufacturer	Country of Origin
		Hyundai Heavy Industries Co.Ltd	Kyongnam-Do, Korea, Republic of
	Ebara Corporation		Japan
	ITT Bell & Gossett		United States
	KSB Guinard		F-36004, France
	Torishima Pump MFG Co. LTD		Japan
	ITT FLYGT AB		Sweden
	REGENT PUMPS		Australia
	Biral A.G		Switzerland
	SPP LTD		Berkshire, United Kingdom
	SEWERAGE - MAIN PUMP	ALSTOM FLUIDES MECANIQUES(FRANCE)	France
77		ABS PUMPS INTERNATIONAL AB	Sweden
	Ingersoll Dresser Pumps		Gateshead, United Kingdom
	Ingersoll Dresser Pumps		Annandale, NJ 08801 USA, Italy
	HITACHI PLANT TECHNOLOGIES		Tokyo, Japan
	ANDRITZ		Graz, Austria
	BAVEY PUMPS		United Kingdom
	EIM PUMPS		Japan
	FLOWSERVE		United Kingdom
	FLOWSERVE		France
	FLYGT (ITT GROUP)		Germany
	WEMCO		United States
	HOMA		Australia

Sr.#	Material	Manufacturer	Country of Origin
78	PUMPS - SCREW - SEWERAGE APPLICATION	HERBORNER PUMPEN TECHNIK (HERBORNER PUMPFABRIK) KUBOTA Ritz Messwandler Goulds Pumps Inc SPAANS BABCOCK VANDEZANDE	Herborn, Germany Tokyo, Japan Hamburg, Germany United States Netherlands Belgium Germany
		KSB Ritz Messwandler Pleuger Worthingtom GmbH / INGERSOLL DRESSER	Hamburg, Germany Hamburg, Germany
		Goulds Pumps Inc Aurora Pump Grundfos	United States United States Martin Bachs VEJ 3, Denmark
79	PUMPS - SUBMERSIBLE - SEWERAGE APPLICATION	Biral A.G Vioght FLOWSERVE FLOWSERVE FLYGT (ITT GROUP) WALLWIN PUMP JACUZZI MELLOR ROBOT (ITT GROUP) T-T PUMPS	Switzerland 89510 Heidenheim, Germany United Kingdom France Germany United Kingdom United States South Africa Netherland United Kingdom

Sr.#	Material	Manufacturer	Country of Origin
80	PUMPS - PROGRESSIVE CAVITY - SEWERAGE APPLICATION	Sykes Picavant Alfa Laval INGERSOLL DRESSER Water MONO MOYNO- ROBBINS NEMO (NETZECH) SPEEPEX INC WORTHINGTON	United Kingdom 0, Sweden United States United Kingdom United Kingdom United Kingdom United States Germany
81	PUMPS - RECESSED IMPELLER SEWERAGE APPLICATION	EMC 2 Corporation Yeomans Chicago Pumps WEMCO INGERSOLL DRESSER MORRIS KSB	United States United States United States United States United States Germany
82	PUMPS - RECESSED IMPELLER SEWERAGE APPLICATION	Clyde Union Limited (Formerly Clyde Pumps) SPP Ltd ABS PUMPS INTERNATIONAL AB FLYGT (ITT GROUP) Ingersoll Dresser WALLWIN PUMP Hidrostal UNITED STATES PIPE & FOUNDRY CO. AMERICAN CAST IRON PIPE CO.(ACIPCO)	Glasgow, United Kingdom Berkshire, United Kingdom Sweden Germany United States United Kingdom Switzerland United States Birmingham, Alabama, United States

Sr.#	Material	Manufacturer	Country of Origin	
83	DUCTILE IRON PIPES - SEWERAGE APPLICATION	KUBOTA Von Roll Duker Saudi Arabian Ductile Iron Pipes Co(SADIP). Stanton & Stavely Xinxing Ductile Iron Pipes Co. Ltd. - Hebel KOREA CAST IRON PIPE IND (KCIP) Duktus (Formerly Buderus Heiztechnik) ELECTROSTEEL CASTINGS LIMITED CEPHAS PIPELINES CORP Tyco Water PYT LTD Saint - Gobain Xuzhou Pipelines Saint - Gobain Thyssen SVOBODNY SOKOL RIVITSWADE LTD. UNITED STATES PIPE & FOUNDRYCO.	KUBOTA Von Roll Duker Saudi Arabian Ductile Iron Pipes Co(SADIP). Stanton & Stavely Xinxing Ductile Iron Pipes Co. Ltd. - Hebel KOREA CAST IRON PIPE IND (KCIP) Duktus (Formerly Buderus Heiztechnik) ELECTROSTEEL CASTINGS LIMITED CEPHAS PIPELINES CORP Tyco Water PYT LTD Saint - Gobain Xuzhou Pipelines Saint - Gobain Thyssen SVOBODNY SOKOL RIVITSWADE LTD. UNITED STATES PIPE & FOUNDRYCO.	Tokyo, Japan Switzerland Deutschland, Germany Dammam, Saudi Arabia United Kingdom Beijing, China Pusan, Korea, Republic of Sophien Stabe, Germany Kolkata, india Saha-Gu, Korea, Republic of New South Wales, Australia Xuzhou, China Germany LIPETSK ,Russian Federation HAMPSHIRE, SHAWCROSS INDUSTRIAL ESTA UnitedKingdom United States Birmingham, Alabama, United States UnitedKingdom Tokyo, Japan Switzerland Deutschland, Germany

REVIEWED BY:

Sr.#	Material	Manufacturer	Country of Origin
84	DUCTILE IRON FITTINGS - SEWERAGE APPLICATION	Saudi Arabian Ductile Iron Pipes Co(SADIP). Stanton & Stavely Duktus (Formerly Buderus Heiztechnik) ELECTROSTEEL CASTINGS LIMITED CEPHAS PIPELINES CORP Tyco Water PYT LTD Metalska Industrija Varazdin (MIV) Saint - Gobain Maanshan Foundry Co. Ltd. Saint - Gobain Thyssen Ludwig Frischhut GMBH & Co. UG	Dammam, Saudi Arabia United Kingdom Sophien Stabe, Germany Kolkata, India Saha-Gu, Korea, Republic of New South Wales, Australia Croatia Maanshan, China Germany Pfarrkirchen, Germany United Arab Emirates
85	DUCTILE IRON PIPE WRAPPING MATERIALS - SEWERAGE APPLICATION	HENKEL POLYBIT INDUSTRIES LTD Johanson PREMIER COATINGS LTD LONGWRAP SERVIWRAP PAM Tapes FUTURE PIPES INDUSTRIES COMPANY- W L L GULF ETERNIT INDUSTRIES COMPANY LTD. ABU DHABI PIPE FACTORY - W L L	Taiwan, Republic of China United Kingdom United Kingdom Berkshire, United Kingdom United Kingdom Abu Dhabi, United Arab Emirates Dubai, United Arab Emirates Abu Dhabi, United Arab Emirates

CDN DMCC p.

Sr.#	Material	UNITS & FITTINGS - SEWERAGE APPLICATION	Manufacturer	Country of Origin
86	ADVANCED PIPES & CAST COMPANY W L	Fiber Flex Factory	Abu Dhabi, United Arab Emirates	
		Emirates Pipe Factory	Abu Dhabi, United Arab Emirates	
		INTERPLAST CO LTD ABU DHABI RANCHI 2	Abu Dhabi, United Arab Emirates	
		INTERPLAST CO LTD ABU DHABI RANCHI 2	Abu Dhabi, United Arab Emirates	
		Dubai Pipe Factory	Dubai, United Arab Emirates	
		FUTURE PIPES INDUSTRIES COMPANY- W L L	Abu Dhabi, United Arab Emirates	
		Cosmoplast Industrial Co. W.L.L	Sharjah, United Arab Emirates	
		Union Pipe Industry - LLC	Abu Dhabi, United Arab Emirates	
		Simplast SPA	Italy	
		Friatec-Th Jansen	Germany	
		Durapipe - S & LP	Cannock Staffordshire, United Kingdom	
		Amiantit Oman	Next to National Gas Co. Russayl Sul, Oman	
		Georg Fischer Piping System Ltd	Schaffhausen/Switzer, Switzerland	
		Al Dhafra Pipes Factory LLC	Abu Dhabi, United Arab Emirates	
		Inter Pipe Factory	Abu Dhabi, United Arab Emirates	

Sr.#	Material	Manufacturer	Country of Origin
88	DUCTILE IRON MANHOLE COVERS & FRAMES - SEWERAGE APPLICATION	ABU DHABI CARNATION METALINDUSTRIES ESTABLISHMENT Ducast Factory LLCWater GLYNWED PIPESYSTEMS (HELDEN) Norford(Norico)	Abu Dhabi, United Arab Emirates Dubai, United Arab Emirates HTITCHIN, HERFORDSHIRE, UniteKingdom France
89	ALUMINIUM MANHOLE COVERS & FRAMES - SEWERAGE APPLICATION	ABU DHABI CARNATION METALINDUSTRIES ESTABLISHMENT Al Shamsi Ferrous and non FerrousManufacturing (SICAST) ARAX INTERNATIONAL TURNING & BLACKSMITH CENTRE AL TADHAMON GLASS & ALLUMEST. GRANADA METAL CASTING Al Qandeel Auma Rotork Controls Hattersley Heaton Limitorque International Ltd. Tyco Flow Control Hattersley Newman Hender Ltd. Honeywell Vag Armaturen GmbH Rotork Controls	Abu Dhabi, United Arab Emirates Dubai, United Arab Emirates Abu Dhabi, United Arab Emirates Abu Dhabi, United Arab Emirates Abu Dhabi, United Arab Emirates Abu Dhabi, United Arab Emirates United Arab Emirates Germany United kingdom United kingdom United kingdom PRINCETON, NJ 08540, United States United kingdom Morristown, NJ 07962, United States MANNHEIM, Germany United kingdom
90	ACTUATORS (ELECTRIC) - SEWERAGE APPLICATION		

Sr.#	Material	Manufacturer	Country of Origin
	ASP Armaturen Schilling		Germany
	Glenfield Valves Ltd	KILMARNOCK, United Kingdom	
	Glenfield Valves Ltd	KILMARNOCK, United Kingdom	
	BELGICAST INTERNATIONAL SL.	MUNGUIA, Spain	
	S+S Armaturen Technik GmbH	39110 MAGDEBURG, Germany	
	Kubota	Tokyo, Japan	
	Bevard	France	
	Duker	Deutschland, Germany	
	AVK	BIZONVEJ 1, SKOVBY, Denmark	
	DEZURIK INTERNATIONAL LTD	Ontario, united States	
	ECONOSTO	United kingdom	
	Hattersley	Netherlands	
	Mannesmann Demag AG	Germany	
	ECONOSTO International B.V	Netherlands	
	Krombach Armaturen	Germany	
	Erhard GmbH & Co	Germany	
	Crane Cochrane	United States	
	PREMIER VALVES (PTY). Ltd	RANDHART SA, South Africa	
	SLAM STEEL INTL PUBLIC CO LTD.	Thailand	
	TAIYO EXPORT CO.	United States	
	BRAY CONTROLS	United States	
	Hattersley Newman Hender Ltd.	United Kingdom	
	Tyco Thermal Controls	United States	
	Metalska Industrija Varazdin (MIV)	Croatia	
91	GATE VALVES - SEWERAGE APPLICATION		



Sr.#	Material	Manufacturer	Country of Origin
	F.A.F VANA SANAYI VE TICARET LIMITED SIRKETI		Ankara, Turkey
	E. HAWLE ARMATURENWERKE GMBH Georg Fischer Piping System Ltd	4840 VOCKLABRUCK, Austria	Schaffhausen/Switzer, Switzerland
	KSB Italia	Frankenthal, Italy	
	HAM BAKER	United Kingdom	
	GLENFIELD, NETHERLAND	Netherlands	
	EBRO	Bangkok, Thailand	
	GEDORE	Remscheider Strasse 149, Germany	
	GA INDUSTRIES LLC	Cranberry Township, United States	Texas, United States
	KETZ CORPORATION OF AMERICA		
	WOLSTENHOLMES VALVES LIMITED	Bolton BL2 6QF, United Kingdom	
	ADVANCED FLOW TECHNOLOGY(AFTI)	Alberta, Canada	
	Vag Armaturen GmbH	MANNHEIM, Germany	
	Hattersley Heaton	United kingdom	
	ASP Armaturen Schilling	Germany	
	Wouter Witzel BV	Netherlands	
	Glenfield Valves Ltd	KILMARNOCK, United Kingdom	
	BELGICAST INTERNATIONAL SL.	MUNGUIA, Spain	
	S+S Armaturen Technik GmbH	39110 MAGDEBURG, Germany	
	Grove	Italy	
	Kubota	Tokyo, Japan	
	Beyard	France	
	Thevignot Vanadour	France	

Sr.#	Material	Manufacturer	Country of Origin
92	BUTTERFLY VALVES - SEWERAGE APPLICATION	Duker	Deutschland, Germany
	AVK	BIZONVEJ 1, SKOVBY, Denmark	
	DEZURIK INTERNATIONAL LTD	Ontario, united States	
	ECONOSTO	United kingdom	
	Hattersley	Netherlands	
	Mannesmann Demag AG	Germany	
	ECONOSTO International B.V	Netherlands	
	Krombach Armaturen	Germany	
	Erhard GmbH & Co	Germany	
	Keystone	Breda, Netherlands	
	PREMIER VALVES (PTY). Ltd	RANDHART SA, South Africa	
	SIAM STEEL INT'L PUBLIC CO LTD.	Thailand	
	BRAY CONTROLS	United States	
	Hattersley Newman Hender Ltd.	United kingdom	
	Advance Valves	Noida, India	
	Metalska Industrija Varazdin (MIV)	Croatia	
	Valvitalia	Italy	
	Magwen	Germany	
	Saint - Gobain Condonite	Italy	
	KSB Italia	Frankenthal, Italy	
	GLENFIELD, NETHERLAND	Netherlands	
	EBRO	Bangkok, Thailand	
	GA INDUSTRIES LLC	Cranberry Township, united States	
	ADVANCED FLOW TECHNOLOGY(AFTI)	Alberta, Canada	

Sr.#	Material	Manufacturer	Country of Origin
	Vag Armaturen GmBH		MANNHEIM, Germany
	Hattersley Heaton		United kingdom
	ASP Armaturen Schilling		Germany
	ASP Armaturen Schilling		Germany
	Biwater Industries		United kingdom
	Glenfield Valves Ltd	KILMARNOCK, United Kingdom	
	BELGICAST INTERNATIONAL SL.	MUNGUIA, Spain	
	S+S Armaturen Technik GmBH	39110 MAGDEBURG, Germany	
	Grove	Italy	
	Kubota	Tokyo, Japan	
	AVK	BIZONVEJ 1, SKOVBY, Denmark	
	DEZURIK INTERNATIONAL LTD	Ontorio, united States	
	ECONOSTO	United kingdom	
	Hattersley	Netherlands	
	Mokveld Valves BV	Netherlands	
	Mannesmann Demag AG	Germany	
	ECONOSTO International B.V	Netherlands	
	Krombach Armaturen	Germany	
	Erhard GmbH & Co	Germany	
	PREMIER VALVES (PTY).Ltd	RANDHART SA, South Africa	
	SIAM STEEL INTL PUBLIC CO LTD.	Thailand	
	BRAY CONTROLS	United States	
	Hattersley Newman Hender Ltd.	United kingdom	
	Tyco Thermal Controls	United States	
93	NON RETURN VALVES - SEWERAGE APPLICATION		

Sr.#	Material	Manufacturer	Country of Origin
	Metalska Industrija Varazdin (MIV)	Croatia	
Magwen		Germany	
HAM BAKER		United Kingdom	
EBRO		Bangkok, Thailand	
GA INDUSTRIES LLC		Cranberry Township, United States	
ADVANCED FLOW TECHNOLOGY(AFTI)		Alberta, Canada	
Vag Armaturen GmbH		MANNHEIM, Germany	
Claval		United States	
Glenfield Valves Ltd		KILMARNOCK, United Kingdom	
S+S Armaturen Technik GmBH		39110 MAGDEBURG, Germany	
Beyard		France	
AVK		BIZONVEJ 1, SKOVBY, Denmark	
Singer Valve Inc		Surrey, Canada	
Mulric Hydro Projects (Pty) Ltd/ Vent-O-Mat		South Africa	
Erhard GmbH & Co		Germany	
Crane Cochrane		United States	
PREMIER VALVES (PTY). Ltd		RANDHART SA, South Africa	
Metalska Industrija Varazdin (MIV)		Croatia	
Magwen		Germany	
AIR VALVES - SEWERAGE APPLICATION		Schaumburg, United States	
E. HAWLE ARMATURENWERKE GMBH		4840 Vocklabruck, Austria	
Valvulas Irua S.L		48960 Galdacno, Spain	
KSB Italia		Italy	
Adams Valves UK		London WC1V 7QT, United Kingdom	



Sr.#	Material	Manufacturer	Country of Origin
	Farris		United States
	GA INDUSTRIES LLC	Cranberry Township, United States	
	Watergate	Australia	
	Vag Armaturen GmBH	MANNHEIM, Germany	
	Biwater Industries	United kingdom	
	Kubota	Tokyo, Japan	
	Fontaine	United kingdom	
	Waterman	Egypt	
	AWT GmbH	Germany	
	Intovalves Ltd	United kingdom	
	Harland Simon Public Limited	Milton, Keynes, United Kingdom	
	KWT Group	Biddinghuizen, Netherlands	
	Adams Valves UK	London WC1V 7QT, United Kingdom	
	HAM BAKER	United kingdom	
	Nuova Fima	Inorio, Novara, Italy	
	Fantinelli srl	Solbiate Olona VA, Italy	
	SIEMENS FLOW INSTRUMENTS A/S (FORMERLY DANFOSS)	2750 Ballerup, Denmark	
	HONEYWELL, UK	Basildon SS14 3EA, United Kingdom	
	Delta Controls	Surrey, United Kingdom	
	Sydney Smith Dennis Ltd	United Kingdom	
	Square D Company	United Kingdom	
	WIKA ALEXANDER WEIGNAD GmbH & CO.	Wuttemburg, Germany	
95	PENSTOCKS - SEWERAGE APPLICATION	SEWERAGE - INSTITUTION	

Sr.#	Material	Manufacturer	Country of Origin
96	INSTRUMENTATION FOR PRESS, SWITCHES AND GAUGES	ECONOSTO International B.V SOR Inc Bailey & mackey Budenberg Gauge CO.Ltd. BOURDON HAENNI S.A LABOM Honeywell ENDRESS+HAUSER	Netherlands United States Birmingham, B42 1DE, United Kingdom Manchester, United Kingdom Cedex, France HUDE, Germany Morristown, NJ 07962, United States 4153 Reinach, Switzerland
	FANAL	France	Germany
	AMOK CONTROLS	Germany	United States
	DURCK AND TEMP	Baesweiler, Germany	
	Ashcroft Instrument GmbH	San Marcos, California, United States	
	Fluid Components International (FCI)	2750 Ballerup, Denmark	
	SIEMENS FLOW INSTRUMENTS A/S (FORMERLY DANFOSS)		
97	SEWERAGE - INSTRUMENTATION FOR FLOAT/LEVEL SWITCHES	Daniel Measurement & Control Inc. E.G. Kistennmacher GmbH & Co. KG Yokogawa Electric / PMC JOLA INSTRUMENT	United States D-20025 Hamburg, Germany Tokyo 180-8750, Japan Etobicoke, On M8z 5B4, Canada
98	SEWERAGE - REMOTE TERMINAL UNIT (RTU)	FLYGT (ITT GROUP) Yokogawa Electric / PMC	Germany Tokyo 180-8750, Japan
99	SEWERAGE - FIELD	Bailey & mackey Yokogawa Electric / PMC	Birmingham, B42 1DE, United Kingdom Tokyo 180-8750, Japan

Sr.#	Material	Manufacturer	Country of Origin
	INSTRUMENTS	Honeywell Endress+Hauser Metso AG	Morristown, NJ 07962, United States 4153 Reinach, Switzerland
100	SEWERAGE - ELECTRONICMAGNET IC FLOWMETERS	SIEMENS FLOW INSTRUMENTSA/S (FORMERLY DANFOSS) Bailey & mackey Endress+Hauser Metso AG Endress+Hauser Metso AG	2750 Ballerup, Denmark Birmingham, B42 1DE, United Kingdom 4153 Reinach, Switzerland 4153 Reinach, Switzerland
101	SEWERTAUL - RADIOMETRIC LEVEL INDICATOR	Endress+Hauser Metso AG	4153 Reinach, Switzerland
	GAS CHLORINATION SYSTEM - SEWERAGE APPLICATION	Wallance & Tiernan Fischer & Porter Capital Controls Co. Portacel	UL, United Kingdom United States United Kingdom United Kingdom
102		Alldos Eichler GMBH Wallance & Tiernan Electro Catalytic Seven Trent De Nora Denora	Pfinztal (Solingen), Germany UL, United Kingdom Portskewett, United Kingdom Texas 77478, United States Italy
103	HYPOCHLORITE CHLORINATION SYSTEM - SEWERAGE APPLICATION	Corodex Industries Wallance & Tiernan Fischer & Porter Portacel	Abu Dhabi, United Arab Emirates UL, United Kingdom United States United Kingdom
104	CHLORINATION PACKAGE		

Sr.#	Material	Manufacturer	Country of Origin
105	HYPOCHLORITE (CHLORINE) GENERATION UNIT	Wallance & Tiernan Electro Catalytic Seven Trent De Nora Denora	UL, United Kingdom Portskewett, United Kingdom Texas 77478, United States Italy



NOTE2 : PROJECT SPECS AND CONTRACT DRAWINGS SHOULD BE FOLLOWED

APPROVED MATERIALS / VENDORS

Sr.#	Material	Manufacturer /Range	Country of origin
1	MV SWITCHGEAR	SIEMENS	Germany
		SCHNEIDER Electric	FRANCE
		ABB	Czech Republic
		LUCY	UAE
2	RING MAIN UNITS	SCHNEIDER Electric	FRANCE
3	TRANSFORMERS	FEDERAL TRANSFORMERS	UAE
		EMIRATES TRANSFORMERS	UAE
		Tesar	ITALY
		F.G. WILSON	UK
		CATERPILLER	USA/ UK
4	GENERATORS	CUMINS	USA
		Power Co	U.K
		Sterling	India
		SDMO	France
		HIMOINSA	Spain
		Etaone	UAE
		MTU Onsite Energy	Germany
5	Diesel Engines	Welland Power	UK
		MTU	Germany
		Volvo Penta	Sweden



Sr.#	Material	Manufacturer / Range	Country of origin
6	ALTERNATORS	LEROY-SOMER STAMFORD (Acquired by Cummins) MeccAlte Marathon Electric	UK France, Czech Republic Italy/ UK USA
7	UNINTERRUPTABLE POWER SUPPLIES (UPS)	CHLORIDE LIEBERT GE	FRANCE UK GE
8	LV PANELS & DISTRIBUTION BOARDS	EATON/ MEM EATON /CUTTLER HAMMER DORMAN SMITH EATON/MOLLER ABB	UK USA UK/ UAE Germany
9	PVC Conduits & Fittings [Very Heavy Gauge]	DECODUCT MK - EGA Marshall Tufflex	UAE UK UK
10	Flexible GI conduits	Adaptaflex Kopex	UK UK
11	G.I Boxes	MK Barton Powercenter	UK UK UK



Sr.#	Material	Manufacturer /Range	Country of origin
		Crabtree	UK
		DECODEDUCT	UAE
12	GI Trunking & Cable Trays	OBO BETTERMANN	Germany
		Philip Grahame	UK
		SWIFTS LEGRAN	France
		Technical Metal Industries	UAE
13	PVC Cable Trunking	MK - EGA	UK
		Marshall Tufflex	UK
14	PVC ducts	Cosmoplast	UAE
		Hepworth	UK
15	Wires & Cables	Bin Mansour Plastics Factory	UAE
		DUCAB	UAE
		OMAN CABLES	OMAN
		TEKAB	UAE
		GULF CABLES	KUWAIT
		Jeddah Cables	KSA
		Saudi Cables	KSA
		National Cables Industry	KSA
		Elsewedy Cables	World wide
16	CABLE GLANDS & Cable lugs	CMP	UK
		MK	UK
		LEGRAND	FRANCE
17	Wiring Accessories	MEM	
		Crabtree	UK



Sr.#	Material	Manufacturer /Range	Country of origin
18	W/P switches & Industrial switch sockets	M.K Lewden Marechal	UK UK UK
19	Isolators	KATKO NISSAD ABB	Finland Germany Sweden
		Excel	UK
		CommScope / Systimax	USA
		3M	USA
		Leviton	USA
		Nordx	USA
		Tyco/ AMP	Switzerland
		R & M	UK/ USA
20	Structured Cabling Infrastructures	Belden Nexans Corning Cable Systems	UK France USA
		Panduit	USA
		Schneider Electric	
		Legrand	France
		Norden	UK
		TECHLOGIKS	Canada
		MORLEY IAS	UK
21	FIRE ALARM Systems	ESSER	Germany



Sr.#	Material	Manufacturer / Range	Country of origin
	U.T.C FIRE & SECURITY (formerly GE EDWARDS)	USA	
	COOPER	USA	
	GENT	UK	
	Notifier	UK	
	Siemens	Germany	
	Drager (Flame Detector)	UK	
22	Earthing & Lightning Materials	FURSE	UK
		WALLIS	UK
		TOA	Japan
		BOUYER	FRANCE
		MARTIN AUDIO	UK
		Bosch	Netherland , Germany
		QSC	USA
		JBL	USA
23	Public address & Audio Devices	Australian Monitor	Australia
		Denon	Japan
		BLAUPUNKT	USA
		SHURE	USA
		SENNHEISER	USA
		ATEIS	France
24	Analogue cameras & IP CAMERAS	AXIS COMMUNICATION	Sweden
		AERCON VISION	USA
		PELCO (Acquired by Schneider)	USA



Sr.#	Material	Manufacturer / Range	Country of origin
		SAMSUNG	Korea
		INFI NOVA	USA
		BOSCH	Netherlands
		Eneo	Germany
25	Thermal Cameras	FLIR Falitec	USA Germany
26	IP Software	Exacq Vision Milestone Omnicast	USA Denmark Canada
27	Servers	HP	USA
28	Storage for CCTV System	InforTrend Promise Technology MCM Electronics	USA USA USA
29	Network Switches	HP Cisco Systems, Inc. Linksys D-Link Netgear	USA USA Taiwan USA
30	ACCESS CONTROL	AMAG Technology HID Cooper security CDVI Paradox Deister Electronics	USA UK USA UK UK CANADA Germany



Sr.#	Material	Manufacturer / Range	Country of origin
		GE SECURITY	USA
		MAXxess	USA
	Gallagher (formely Cardax)	New Zealand	
31	Master Clock System	Bodet	France
		Gorgy Timing	France
		WESTERSTRAND	SWEDEN
		Mobatime	Switzerland
		Master clock	USA
32	Audio-Visual Systems	SANYO	JAPAN
		CHRISTIE	USA
		PROJECTION DESIGN	USA
		PANASONIC	JAPAN
		CRESTRON	USA
		EXTTRON	USA
		DA-LITE	USA
		MEYER SOUND	USA
		AMX	USA
		ASHLY	USA
		TOA	JAPAN
		DYNALITE	Australia
		VC VIDEO	GERMANY
		ATEIS	France
		STRAND PHILIPS	UK
		CYCLOPS	UK



Sr.#	Material	Manufacturer / Range	Country of origin
		KUPO	TAIWAN
		LDR	ITALY
		AVOLITES	UK
33	Video Conference System	Polycom	USA
		Lifesize	Japan
		CAME	ITALY
		MAGNETIC AUTO CONTROL	Germany
34	POLE BARRIER	FACC	ITALY
		Ditec	ITALY
		Southwest	USA
		Falitec	Germany
35	Perimeter Detection system	SENSTAR STELLAR	CANADA
36	Turnstile gates	Tomsed	USA
		Gunnebo	Sweden
		Optima Engineering	Turkey
37	Under Vehicle Inspection Systems	Teleradio	Singapore
38	Car Plate Recognition Systems	Carmen	Hungary
39	Siren System	Whelen	USA
		MERLAUD	FRANCE
		Federal Signals	USA
40	SMATV	HERSCHMAN	Germany
		IKUSI	Spain
		TRIAX	



Sr.#	Material	Manufacturer / Range	Country of origin
	ALCAD	Spain	Spain
	TELEVIS	Spain	Spain
	WISI	Germany	Germany
41	Static Frequency Converter / 28 VDC	AXA POWER MCM ENGINEERING AVK (Acquired by Cummins)	Denmark U.S.A U.S.A
	HITZINGER	AUSTRIA	AUSTRIA
	PILLER	Germany	Germany
	CHLORIDE	FRANCE	FRANCE
43	DC POWER SUPPLY	ERSKIN	UK
		ADB	Belgium
44	AIRFIELD LIGHTING	CROUSE HINDS THORN	USA FRANCE
45	Cable Joints	RAYCHUM	Germany
		OBO BETTERMANN	Germany
46	G.I Trunking & Cable trays	Philip Grahame SWIFT LEGRAND Technical Metal Industria	UK FRANCE UAE
	Manhole covers	DUCAST	UAE
47		Trojan	Canada
		PMA	Canada
48	LIGHT FIXTURES	Emirates Lighting	UAE
		Bega	Germany



Sr.#	Material	Manufacturer / Range	Country of origin
	Selux	Germany/USA	Germany/USA
	Hubbell	USA	USA
	Lithon	USA	USA
	Prisma	Italy	Italy
	Fael Luce	Italy	Italy
	(Colombo) Ideallux	Italy	Italy
	Reggiani	Italy	Italy
	Thorlux	UK	UK
	Francis Searchlight	UK	UK
	(Thomas & Betts) DTS	France	France
	Arlus	France	France
	Zumtobel	Austria	Austria
	Tridonic Atco	Austria/Australia	Austria/Australia
	2D Collection	TURKEY	TURKEY
	Gecem	Turkey	Turkey
	Indelague	Portugal	Portugal
	E-lite / Domino	Italy	Italy
	Arcluce	Italy	Italy
	Elkovo	Czech Republic	Czech Republic
	Reiss	Germany	Germany
	Ruud Lighting	USA	USA
	Ventilux	IRL AND	IRL AND
	Menvier	UK	UK
	Sylvania	USA/Europe – Far East	USA/Europe – Far East
49	Lamps		



Sr.#	Material	Manufacturer / Range	Country of origin
		Osrarn	USA/Europe/Russia – Far East
50	BMS system	KIEBACK AND PETER Johnson Controls	Germany
		Honeywell	
51	G.I poles	GALVANCO GALVACOAT	KSA
		OMEGA	UAE
52	1,2,3 compartmentPVC trunkings	BABTAIN	KSA
		M.K	UK
53	Under floor Trunking	DECODUCT	UAE
		M.K,	UK
54	Under floor service outlets	Philip Grahame Davis	UK
		M.K,	UK
55	Terminal Strip (Telephone)	KRONE	UK
56	CUTOOUT BOX for Lighting Poles	BIAX	INDIA
		KBC	
57	Fiber Optic Tx\Rx	Optelecom-NKF Cominet	UK USA
		TYCO,	Europe
58	MIICC cables	Pyrotentax	Europe
		Prysmian/ Pirelli	UK
59	Fire Alarm Cables	Firetek/ Tekab	UAE



Sr.#	Material	Manufacturer / Range	Country of origin
60	PANELS ENCLOSURE	BICC/ Ducab HIMEL (Acquired by Schneider) Logstrup Elsteel Gulf Metal Craft (GMC) Sun Shine Middle East Switchgear Al Bilad Blokset prisma	UAE Spain Denmark Sri Lanka UAE UAE UAE UAE UAE FRANCE
61	FLEXIBLE 3C, 4C CABLE PVC	TEKAB	UAE
62	CABLE WARNING TAPE	Corys / KANGARO PLASTIC DECODUCT	UAE UAE
63	ELECT. CABLE TILES	AL SHALAN TAWAKKAL	UAE UAE
64	MV/LV PACKAGE SUBSTATION	AL HAMAD MATELEC	UAE Lebanon
65	Explosion Proof Fittings	DTS (Thomas & Betts) GOVAN	Australia



NOTE : PROJECT SPECS AND CONTRACT DRAWINGS SHOULD BE FOLLOWED.

Sr. No.	Material	Manufacturer / Supplier	Country of Origin
1	ARCHITECTURAL WORKS ALUMINIUM WORKS (SUPPLY AND INSTALLATION)	AL ARABI AL AMER GLASS & ALUMINUM GOLDEN STEEL & ALUMINUM WORKS JAGUAR METALLIC INDUSTRIES AL HABBER ALUM& GLASS AL HADA ALUMINIUM INTERNATIONAL EASTERN INTERNATIONAL NBIN DASMIL DOORS ARAZ AL JABAL AL YARMOK CLASSIC	
3	GLAZING FOR ALUMINUM DOORS AND WINDOWS	GLAVERBEL	
4	CURTAIN WALL GLASS	SANGOPAN GARDIAN	
5	AUTOMATIC DOORS	CRAWFORD MIDDLEEAST	
6	FIRE RATED STEEL DOORS, FRAMES & ACCESSORIES	MIDDLE EAST INSULATION LLC	

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Sr. No.	Material	Manufacturer / Supplier	Country of Origin
7	KITCHEN EQUIPMENTS (SUPPLY AND INSTALLATION)	EMIRATES KITCHEN EQUIPMENTS CO.LLC AL JAZIRA EQUIPMENTS& TECHNICAL SERVICES	
8	KITCHEN CABINET	VERONA TRADING AL MA WARED KITCHENS	
9	FABRIC, ACOUSTIC, CARPET AND GYPSUM BOARD	TETCO .(THEATRE ENGINEERING TRADING	
10	MARBLE AND GRNITE (SUPPLY AND INSTALLATION)	ARABIAN STONE FACTTORY AGABUILDERS SQUARE MARBLE	
11	MARBLE & GRANITE	AL NABOODATH GYPSUM CARRARA MIDDLE EAST UNION MOSAIC & MARBLE CO AL HABTOOR MARBLE CO	
12	RAISED ACCESS FLOORING	FEDERAL BUILDING INDUSTRIES -LINDNER USA GULF COMPUTER SUPPORT SYSTEM-PATE USA MEHRTASHTRADING -JANSEN BELGIUM	USA
13	MODULAR DEMOUNTABLE PARTITIONS	DEKO EMIRATES	BELGIUM



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
		ARCTIC	
		AL REYAMI	
		CLOISALL	
		GIBCA (HUFCOR)	
14	ACOUSTIC MOVABLE WALLS	OBAIDHUMAID AL TARYER \GEZZE MIDDLE EAST	MEDITARRANEAN BUILDING MATERIALS
15	CERAMIC FOR FLOORS, WALLS, SKIRTING (WHITE BODY)	DORMAGULF PAK CERAMIC	EMIRATES CERAMIC ABU DHABI PRRCLEING
16	MIRROR (SUPPLY AND INSTALLATION)	WHITE ALUMINIUM.CO	AL RAYAMI GLASS ,ALUM L.L.C
17	VINYL FLOORING & SKIRTING (SUPPLY AND INSTALLATION)	AL NAFEES FORBO	SULTACO,ABU DHABI , UAE
18	RAISED FLOORING (SUPPLY AND INSTALLATION)	MBM .(MEDITERRANEAN BUILDING MATERIALS) AL NAFEES AVAYO LINDER	MBM .(MEDITERRANEAN BUILDING MATERIALS)



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
19	ARTIFICIAL GRASS FOR FOOTBALL GROUND & EQUIPMENTS	HADIR PROJECTS & ENVIRONMENT SYSTEM	
20	LOCKERS (SUPPLY AND INSTALLALLATION)	GIPCA FURNITURE INDUSTRY CO LLC	
21	IRONMANGERY WORKS	AL KAMDA TRADING	
		DORMA GULF	
		SILVERSHORE TRADING	
		HAROON ARCHITECTUREAL HARDWARE CO.	
		MODRIC RANGE , SILVER HORE TRADING	
22	IRONMONGERY FOR TIMBER DOORS (SOLID STAINLESS STEEL)	VACHETT, AL KAMDA TRADING	
		JADO, D-LINE , HAROON CO. W.L.L	
		DORMA	
23	ALUMINIUM IRONINONGERY	SAVIO	
		GISSIE	
		D LINE	
24	IRONMONGERY FOR ALUMINIUM DOORS (WITH MASTER KEY FACILITY)	JCL	
		YALE	
		ELITE	
25	PAINT	JOTUNPAINT	



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
		EURO GENERAL CONTRACTING	
		NATIONAL PAINT	
26	SEATING FOR LECTURE HALL	MBM (MEDITERRANEAN BUILDING MATERIALS)	
27	FALSE CEILING WORKS	CONMAT LLC DAMPA	
		TMI (TECHNICAL METAL INDUSTRIAL CO .)	
		FRIBA	
		KNAUF	
		GYPROC	
		GYPSEMA	
		AL SHIRAWI	
		SPEED WELL DÉCOR	
		PARAGON	
		DECO EMIRATES	
		AL REYAMI	
		ARCTIC	
		INTEX UNIVERSAL	
		HORMAN	
		POLYNOM	
29	GYPSUM PARTITION WORKS	DAYBAR IND.	CANADA
30	FIRE ESCAPE DOOR WITH PANIC EXIT DEVICE	DORMA	

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Sr. No.	Material	Manufacturer / Supplier	Country of Origin
31	DOOR CLOSER	BRITON	
32	PANIC EXIT DAVICE FOR FIRE DOOR	NEWMAN TONGKS UNION	UK
33	GLASS -AFT SOLAR REFTEETIVE AS WELL AS AGAINST OBSTRUCTION OF VISION	BRITON UNION	UK
34	SUSPENDED CEILINGS	EMIRATES GLASS DUBAI LIBBEY OWENSFORD GLASS INTRACO	UAE
35	SUSPENDED CEILINGS	GLAVERBEL ,GUTAL TRADING DUBAI	UAE
36	EVERITE NUTEC - SOUTH AFRICA	LUXALON FORM HUNTER DOUGLAS	
37	BORAL	SUPPLIED BY ARAB TECH EST BORAL - AUSTRALIA	SOUTH AFRICA AUSTRALIA
38	NATIONAL GYPSUM	NATIONAL GYPSUM FROM MAC AL GURG	KSA
	BRITISH GYPSUM	LIBEL DUBAI L.L.C	UK
	FIBRE GLASS SCREEN FABRIC	MAC AL GURG	
	ACCESS PANELS	AL FALAH BLDG MATERIALS SPEEDWELLDECOR	
		JOTUN UAE LTD	
		BERGER PAINTS HEMPEL	
		PAINT	



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
		INTERNATIONAL PAINTS	
		SIGMA	
		EMIRATES GLASS DUBAI	UAE
		FORD GLASS FROM INTRACO	UAE
		DUBAI	
		GLAVERBCL	
39	MIRRORS IN TOILET	HENKLE-POLYBIT	
		SEAL WELL INSULATION	
		BEAM ENGINEERING & CONT.	
		PROTECT MIDDLE EAST LLC.	
		AWAZEL	
		SODAMCO	
		AL RAYAMI INSULATION	
		TECHNICAL LINE PROJECT	
		(ORBIT)	
		SHELL	
		DUPROOF	
		BETAGUM	
		BASF MIDDLE EAST	
		CONSTRUCTION CHEMICALS	
		ORBIT	
		SERVICISED	
		SCHLEGEL	
40	WATER PROOFING MATERIALS		

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Sr. No.	Material	Manufacturer / Supplier	Country of Origin
41	WATER STOPPING BARS	FOSROC SPECIALITY ENG.CHEMIC DEGUSSA (MBT) SIKA TRICOSAL - EMIRATES SPECIALITIES OR SIMILAR TO APPROVAL	
42	WATERPROOFING ADDITIVES	DEGUSSA (MBT) FOSROC DAVID BALL M.E. SIKA EMIRATES CHEMICALS	
43	EPOXY COATING NITOFLLOOR FC140 REZEX EP	ALGURG FOSROC - DUBAI CORMIX M.E. - DUBAI	UAE UAE
44	PROTECTION BOARD	PROTECTION COURSE OF SEAL TIGHT W.R. MEADOWS ALCO	
45	LIQUID APPLIED DAMP PROOF COATING (FOR SUBSTRUCTURE)	TEXMASTIC INT (USA) EMIRATES SPECIALITIES FOSROC KELLIBID - DUBAI EMIRATES SPECIALITIES - DUBAI	UAE UAE UAE

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Approved Materials / Vendors(Architectural and Civil Materials)



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
46	GEOTEXTILE	TYPAR FROM DU PONT U.K AL NAHDA CONT.& TRADING TERRAM POLYFELT	UK AUSTALIA
		EMIRATES SPECIALITIES,DUBAI	
47	NON WOVEN POLYESTER SEYNTHETIC FABRIC FILTER MEMBRENE (GEOTXTILE)	GEOFABRIC	
48	POLYTHENE SHEET (VAPOUR BARRIER)	KANGAROO PLASTICS - DUBAI	UAE
49	PART OR SINGLE COMPONENT POLYSULPHIDE SEALANT	FOSROC MBT MIDDLE EAST BCR	
		DOW CORNING	
		FOSROC BCR	
50	BITUMEN IMPREGNATED FIBRE BOARD	HUNTON BOARDS FROM MAC AL GURG	
51	DAMP PROOF COATING (FOR SUB- STRUCTURE)	FOSROC KELLBIT MBT MIDDLE EAST	
		FALCON CHEMICATS	
		AL NAHADA CONT & TRADING	ITALY
52	ROOF WATER PROOFING MEMBRANE DERBIGUM SP OF DERBIGUM	INDEX , TESTUDO , TRALY , DESERT ROOFING DUBAI	

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Sr. No.	Material	Manufacturer / Supplier	Country of Origin
	PARAFOR SOLO OFF OF SIPLAST	SIPLAST (FRANCE) - SIPLAST DUBAI	FRANCE
53	ANTI-ROT WATER PROOFING TO FLOWER BOXES	DERBIGUM (ITALY) - AL NAHADA CONT & TRADING	ITALY
	DERBIGUM SP	SIQLAST (FRANCE) - SIPLAST DUBAI	FRANCE
	GRAVIFLAX	FOSROC	
54	BITUMINIOUS MASTIC	DEGUSSA (MBT)	
55	DPC MEMBRANE	FEB MIDDLE EAST	
	SIBETASTO	AL NAHADA CONT & TRADING - DUBAI	UAE
	ADEPRIMAIRE	SIPLAST	
56	JOINT SEALANT	EMIRATES SPECIALITIES CO	
		AL GURG FOSROC	
57	WATER STOP BARS	FOSROC	
		EMIRATES SPECIALEST	
		BASF MIDDLE EAST	
		CONSTRUCTION CHEMICALS	
		HENKLE-POLYBIT	
58	LINING FOR SEWAGE MANHOLES	DEGUSSA (MBT)	
	BLOCK WORKS	FOSROC	

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Sr. No.	Material	Manufacturer / Supplier	Country of Origin
59	INTERLOCK , BLOCK, AND KERBSTONE SUPPLIER	BUCOMAC INDUSTRIES LTD TOP CONCRETE PRODUCTS CONTECH TRANS GULF PRODUCTS TERRAZO LTD AL SULTAN INDUSTRIAL CEMENT PASCO	
60	BLOCK WORK AND PLASTER ACCESSORIES	TMI (TECHNICAL METAL INDUSTRIAL CO) EMIRATES SPECIALITIES	
61	BLOCK (UNIT MASONARY)	AI WATHBA BLOCK FACTORY APEX CONCRETE BLOCK BUCOMAC INDUSTRIES LTD CONTECH TRANS GULF PRODUCTS AL SULTANINDUSTRIAL CEMENT PASCO	
62	CONCRETE BLOCKS	EMCON AL JAZZERA JUMA AL MAJID EST APEX	
63	SOLID / HOLLOW BLOCKS	JUMA AL MAJID	



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Sr. No.	Material	Manufacturer / Supplier	Country of Origin
		EMCON PHONEIX	
64	WALL TIES	HEMAX (HARRIS & EDGAR) MRF (BW FIXING) CARADAN CATNIC	
65	PLASTER WORKS		
66	PLASTER CHIMECALS PLASTER ACCESSORIES	EXPAMET METAL CO. LTD CARADON CATNIC LTD METAL EXPANSION FACTORY DUBAI SODAMCO SYNAXIS , SAVITO VETONIT CO	UAE
	ROAD WORKS		
67	ROADS GUARD RAIL	AL WATHBA STEEL & ALUMINUM WORKS	
68	ROAD MARKING WORKS	PRIZMO GULF ESTABLISHMENT	
69	ROAD MARKING PAINT	PRISMO GEAP	
70	HEEL KERB	CONSENT - DUBAI APEX CONCRETE BLOCK FACTORY - DUBAI	UAE UAE



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
		JUMA AL MAJID - DUBAI	UAE
71	KERB STONE	CONSENT - DUBAI	UAE
		CONSENT - DUBAI	UAE
		JUMA AL MAJID	UAE
		ROYAL CONCRETE PRODUCTS	
72	FLUSH KERB	DITTO	
		JUMA AL MAJID,DUBAI, UAE	
73	INTERLOCK PAVING	CONSECH , DUBAI	
		APPEx CONCRETE BLOCK ,DUBAI	
		JOSEPH ADVERTISERS	
74	ROAD SIGNS , INFORMATION SIGNS	GIFFIN ROAD SIGNS	
		BRIGHT SIGNS	
75	EXPANSION JOINTS FOR BRIDGES	BASF MIDDLE EAST	
		CONSTRUCTION CHEMICALS	
		FALCON CHEMICALS	
76	CONCRETE WORKS	FOSROC	
	CONCRETE REPAIR MATERIALS	SIKA	
		DEGUSSA(MBT)	
		EMIRATES SPECIALITIES	
77	COCRETE REPAIR MATERIALS, PILEHEAD TREATMENT, GROUTING, ADHESIVE, HARDNER, PLASTER AND CONSTRUCTION	FOSROC	
		BASF MIDDLE EAST	
		CONSTRUCTION CHEMICALS	



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
	CHEMICALS	SODAMCO	
		SIKA	
78	PRE-CAST CONCRETE CLAUSTRA	TRI STAR CONCRETE	
79	FOAM CONCRETE SCREED	ACT	
		UNIMIX	
		READYMIX BETON	
		NATIONAL READYMIX	
80	READYMIX CONCRETE SUPPLIER	TOPMIX	
		READYMIX GULF BEATON	
		ARABIAN READYMIX	
		EDAMA , GERMANY	GERMANY
81	LIGHT WEIGHT CONCRETE	DAREX AE4 FROM CONMIX	
		FOSROC	
82	NON-SHRINK GROUT	MBT MIDDLE EAST	
		BCR	
			UAE
83	LEVELLING COMPOUNDS	CORMIX M.E.	
	REZEX R511	FOSROC , AL GURG FOSROC	UAE
	NITOFLOOR LEVELTOP GP	EMIRATES SPECIALITIES	UAE
	BCR LEVELLING COMPOUND	FOSROC	
		SIKA	
		TREMCA	
		FALCON CHEMICALS	
84	SODIUM SILICATE FLOOR HARDNER	SPECIALITY ENG CHEMICALS	



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
	NITO FLOOR LITHURIN	DPH CONNIX M.E DUBAI BCR LIQUID EMIRATES	
		SPECIALITY DUBAI	
		RAS AL KHIMAH COMPNY	
		ABU DHABI NATIONAL CEMENT	
85	CEMENT SUPPLIER	NATIONAL CEMENT FACTORY AL SULTAN INDUSTRIAL CEMENT	
	STEEL WORKS	PRODUCT OF UAE	
86	STEEL REINFORCERNT	SAUDI STEEL OR SIMILAR CONFIRMING TO B.S. QATAR STEEL	
87	BRC MESH	AL GHAZAL IRON WORKS AL GURG BLDG SERVICES	UAE
88	WELDED WIRE MESH	CICON	
	REINFORCEMENT STEEL SUPPLIER (AL GHAZAL IRON WORKS SEVEN SES STEEL INDUSTRIES EMIRATES STEEL INDUSTRIES .	
89	EMITATES OR QATAR STEEL)	UAE UNION REBAR CICON	
90	CHAIN LINK FENCE	LINK MIDDLE EAST . LTD	



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
	OTHER ITEMS	FENCE INTERNATIONAL	
91	UNTI-TERMITE	TERMINEX	FROM ARABIAN AGRICULTURE
	DURSBAN 4TC	GOLDEN FALCON	
92	TILE ADHESIVE	DEMON TC BIFLEX TC FOSROC DEGUSSA (MBT) CONMIX	RAK CERAMICS-LATICRETE AL SHAYA TRADING -BAL ROOFING MIDDLE EAST AL GABER FACTORY
93	CLADDING MATERIALS AND SANDWICH PANNEL	TECHNICAL SUPPLIES & SERVICES CO.	
94	NON WOVEN FABRIC FILTER MEMBRENE	TEEJAN TRADING	
95	EXTRUDED POLYSTERENE BOARD INSULATION	ISO FOAM E-FOAM ELECTRONIC & ENGINEERING INDUSTRIES	UNITED QUARRIES

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Sr. No.	Material	Manufacturer / Supplier	Country of Origin
96	ROCK MATERIAL SUPPLIER	FUJAIRAH ROCK AND AGGREGATE CO.	
	EXTRUDED RIGID POLYSTYRENE BOARDS INTERLOCKING TYPE	GIBCA CRASHING AND QUARRY OPERATIONS CO.	
97	ROOFMATE ESSCOFOAM	COOL ROOF SAUDI DOW CHEMICAL CLOISALL - DUBAI	KSA UAE
98	PAINT FOR KERBS	ENERGY SAVING KUWAIT JOTUN UAE LTD BORAL AUSLRALIA	KUWAIT UAE
99	GYPSUM PLASTER BOARD	NTIONAL GYPSUM - KSA BRITISH GYPSUM FORM MAC AL GURG	
100	VEHICULAR TRAFFIC DECK COATINGS	DEGUSSA (MBT) FOSROC SIKA DON CONSTR.PRODUCTS (SUNDIP TRADING) JOTUN PAINTS	
101	FIRE STOP SEALANTS	NULLFIRE PROTECTION APS TRADING DIVISION - DUBAI	UAE



Sr. No.	Material	Manufacturer / Supplier	Country of Origin
		DIOW CORNING EMIRATES SPECILAITIAS CO. - DUBAI	UAE
102	STEP IRON	NBM / MAC AL GURG	
103	CORNER GUARDS	EMIRATES SPECIALITIES CONSTRUCTION SPECIALITIES PENINSULA BLDG MATERIALS	
104	LAMINATE	FORMICA LTD . EUGLAND AL FALAH BUILDING MATERIALS DUBAI	
		PERSTORP ,EMIRATES TRADING AGENCY	
		UNION FACTORY	
105	STOVE ENAMELED FINISHED STEEL COLD ROLLED CUPBORED		
106	SKY LIGHT ROOFING	AL MAMARY ALUM & SKY LIGHT FACTORY	

VARIOUS CONSTRUCTION WORKS IN HAIL & QURAYYA -MEP BASELINE PROGRAM OF WORKS

Activity ID	Activity Name	Start	Finish	Original Duration
	Various Construction works in Hail & Quraya Project -MEP Baseline Program Rev.00	08-Nov-22	02-Feb-24	452
Engineering		08-Nov-22	05-May-23	148
Subcontractor PQ		08-Nov-22	14-Dec-22	29
Submission		08-Nov-22	24-Nov-22	15
RA-SP-PQS-1000	Preparation and submission of FLS Contractor PQ	08-Nov-22	24-Nov-22	15
Approval		25-Nov-22	14-Dec-22	14
RA-SP-PQA-1000	Review and Approval of FLS Contractor PQ	25-Nov-22	14-Dec-22	14
Design Submission and Approval by Jacobs		15-Dec-22	21-Jan-23	33
Site One		15-Dec-22	21-Jan-23	33
Submission of Design to Jacobs		15-Dec-22	05-Jan-23	19
FLS		15-Dec-22	05-Jan-23	19
RA-SP-DSJ-S1-FL-101	Preparation and Submission of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	15-Dec-22	30-Dec-22	14
RA-SP-DSJ-S1-FL-102	Preparation and Submission of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	16-Dec-22	31-Dec-22	14
RA-SP-DSJ-S1-FL-103	Preparation and Submission of FIRE ALARM SYSTEM -PLAN VIEW-TUNNEL	17-Dec-22	02-Jan-23	14
RA-SP-DSJ-S1-FL-104	Preparation and Submission of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	19-Dec-22	03-Jan-23	14
RA-SP-DSJ-S1-FL-105	Preparation and Submission of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW-TUNNELS	20-Dec-22	04-Jan-23	14
RA-SP-DSJ-S1-FL-106	Preparation and Submission of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	21-Dec-22	05-Jan-23	14
Approval of Design by Jacobs		31-Dec-22	21-Jan-23	19
FLS		31-Dec-22	21-Jan-23	19
RA-SP-DAJ-S1-FL-101	Review and Approval of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	31-Dec-22	16-Jan-23	14
RA-SP-DAJ-S1-FL-102	Review and Approval of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	02-Jan-23	17-Jan-23	14
RA-SP-DAJ-S1-FL-103	Review and Approval of FIRE ALARM SYSTEM -PLAN VIEW-TUNNEL	03-Jan-23	18-Jan-23	14
RA-SP-DAJ-S1-FL-104	Review and Approval of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	04-Jan-23	19-Jan-23	14
RA-SP-DAJ-S1-FL-105	Review and Approval of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW-TUNNELS	05-Jan-23	20-Jan-23	14
RA-SP-DAJ-S1-FL-106	Review and Approval of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	06-Jan-23	21-Jan-23	14
Site two		15-Dec-22	21-Jan-23	33
Submission of Design to Jacobs		15-Dec-22	05-Jan-23	19
FLS		15-Dec-22	05-Jan-23	19
RA-SP-DSJ-S2-FL-101	Preparation and Submission of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	15-Dec-22	30-Dec-22	14
RA-SP-DSJ-S2-FL-102	Preparation and Submission of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	16-Dec-22	31-Dec-22	14
RA-SP-DSJ-S2-FL-103	Preparation and Submission of FIRE ALARM SYSTEM -PLAN VIEW-TUNNEL	17-Dec-22	02-Jan-23	14
RA-SP-DSJ-S2-FL-104	Preparation and Submission of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	19-Dec-22	03-Jan-23	14
RA-SP-DSJ-S2-FL-105	Preparation and Submission of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW-TUNNELS	20-Dec-22	04-Jan-23	14
RA-SP-DSJ-S2-FL-106	Preparation and Submission of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	21-Dec-22	05-Jan-23	14
Approval of Design by Jacobs		31-Dec-22	21-Jan-23	19
FLS		31-Dec-22	21-Jan-23	19
RA-SP-DAJ-S2-FL-101	Review and Approval of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	31-Dec-22	16-Jan-23	14
RA-SP-DAJ-S2-FL-102	Review and Approval of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	02-Jan-23	17-Jan-23	14
RA-SP-DAJ-S2-FL-103	Review and Approval of FIRE ALARM SYSTEM -PLAN VIEW-TUNNEL	03-Jan-23	18-Jan-23	14
RA-SP-DAJ-S2-FL-104	Review and Approval of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	04-Jan-23	19-Jan-23	14
RA-SP-DAJ-S2-FL-105	Review and Approval of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW-TUNNELS	05-Jan-23	20-Jan-23	14
RA-SP-DAJ-S2-FL-106	Review and Approval of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	06-Jan-23	21-Jan-23	14
Design Submission and Approval by CMW		23-Jan-23	07-Mar-23	38
Site One		23-Jan-23	07-Mar-23	38
Submission of Design to CMW		23-Jan-23	18-Feb-23	24
FLS		23-Jan-23	18-Feb-23	24
RA-SP-DS-S1-FLS-100	Preparation and Submission of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	23-Jan-23	07-Feb-23	14
RA-SP-DS-S1-FLS-100	Preparation and Submission of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW-TUNNELS	25-Jan-23	09-Feb-23	14
RA-SP-DS-S1-FLS-100	Preparation and Submission of FIRE ALARM SYSTEM -PLAN VIEW-TUNNEL	27-Jan-23	11-Feb-23	14
RA-SP-DS-S1-FLS-100	Preparation and Submission of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	30-Jan-23	14-Feb-23	14
RA-SP-DS-S1-FLS-100	Preparation and Submission of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	01-Feb-23	16-Feb-23	14
RA-SP-DS-S1-FLS-100	Preparation and Submission of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	03-Feb-23	18-Feb-23	14
Approval of Design by CMW		08-Feb-23	07-Mar-23	24
FLS		08-Feb-23	07-Mar-23	24
RA-SP-DA-S1-FLS-10C	Review and Approval of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	08-Feb-23	23-Feb-23	14
RA-SP-DA-S1-FLS-10C	Review and Approval of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW-TUNNELS	10-Feb-23	25-Feb-23	14
RA-SP-DA-S1-FLS-10C	Review and Approval of FIRE ALARM SYSTEM -PLAN VIEW-TUNNEL	13-Feb-23	28-Feb-23	14
RA-SP-DA-S1-FLS-10C	Review and Approval of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	15-Feb-23	02-Mar-23	14
RA-SP-DA-S1-FLS-10C	Review and Approval of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	17-Feb-23	04-Mar-23	14
RA-SP-DA-S1-FLS-10C	Review and Approval of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	20-Feb-23	07-Mar-23	14
Site two		23-Jan-23	07-Mar-23	38
Submission of Design to CMW		23-Jan-23	18-Feb-23	24
FLS		23-Jan-23	18-Feb-23	24
RA-SP-DS-S2-FLS-100	Preparation and Submission of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	23-Jan-23	07-Feb-23	14
RA-SP-DS-S2-FLS-100	Preparation and Submission of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW-TUNNELS	25-Jan-23	09-Feb-23	14
RA-SP-DS-S2-FLS-100	Preparation and Submission of FIRE ALARM SYSTEM -PLAN VIEW-TUNNEL	27-Jan-23	11-Feb-23	14
RA-SP-DS-S2-FLS-100	Preparation and Submission of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	30-Jan-23	14-Feb-23	14
RA-SP-DS-S2-FLS-100	Preparation and Submission of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	01-Feb-23	16-Feb-23	14
RA-SP-DS-S2-FLS-100	Preparation and Submission of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	03-Feb-23	18-Feb-23	14
Approval of Design by CMW		08-Feb-23	07-Mar-23	24
FLS		08-Feb-23	07-Mar-23	24
RA-SP-DA-S2-FLS-10C	Review and Approval of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	08-Feb-23	23-Feb-23	14
RA-SP-DA-S2-FLS-10C	Review and Approval of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW-TUNNELS	10-Feb-23	25-Feb-23	14
RA-SP-DA-S2-FLS-10C	Review and Approval of FIRE ALARM SYSTEM -PLAN VIEW-TUNNEL	13-Feb-23	28-Feb-23	14
RA-SP-DA-S2-FLS-10C	Review and Approval of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	15-Feb-23	02-Mar-23	14
RA-SP-DA-S2-FLS-10C	Review and Approval of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	17-Feb-23	04-Mar-23	14
RA-SP-DA-S2-FLS-10C	Review and Approval of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	20-Feb-23	07-Mar-23	14
Shop drawing Submission and Approval		10-Mar-23	05-May-23	46
Site One		10-Mar-23	05-May-23	46

VARIOUS CONSTRUCTION WORKS IN HAIL & QURAYYA -MEP BASELINE PROGRAM OF WORKS

Activity ID	Activity Name	Start	Finish	Original Duration
	Shop drawing submission			
	FLS			
	RA-SP-SDS-S1-FL-100 Preparation and Submission of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	10-Mar-23	15-Apr-23	32
	RA-SP-SDS-S1-FL-100 Preparation and Submission of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW AND SECTIONS -TUNNELS	13-Mar-23	01-Apr-23	18
	RA-SP-SDS-S1-FL-100 Preparation and Submission of FIRE ALARM -INSTALLATION DETAILS	15-Mar-23	04-Apr-23	18
	RA-SP-SDS-S1-FL-100 Preparation and Submission of FIRE ALARM SYSTEM -PLAN VIEW AND SECTIONS -TUNNEL	17-Mar-23	06-Apr-23	18
	RA-SP-SDS-S1-FL-100 Preparation and Submission of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	20-Mar-23	08-Apr-23	18
	RA-SP-SDS-S1-FL-100 Preparation and Submission of FIRE FIGHTING SYSTEM -INSTALLLATION DETAILS	22-Mar-23	11-Apr-23	18
	RA-SP-SDS-S1-FL-100 Preparation and Submission of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	24-Mar-23	13-Apr-23	18
	RA-SP-SDS-S1-FL-100 Preparation and Submission of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	27-Mar-23	15-Apr-23	18
	Shop drawing Approvals	31-Mar-23	05-May-23	28
	FLS	31-Mar-23	05-May-23	28
	RA-SP-SDA-S1-FL-10C Review and Approval of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	31-Mar-23	15-Apr-23	14
	RA-SP-SDA-S1-FL-10C Review and Approval of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW AND SECTIONS -TUNNELS	03-Apr-23	18-Apr-23	14
	RA-SP-SDA-S1-FL-10C Review and Approval of FIRE ALARM -INSTALLATION DETAILS	05-Apr-23	24-Apr-23	14
	RA-SP-SDA-S1-FL-10C Review and Approval of FIRE ALARM SYSTEM -PLAN VIEW AND SECTIONS -TUNNEL	07-Apr-23	26-Apr-23	14
	RA-SP-SDA-S1-FL-10C Review and Approval of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	10-Apr-23	28-Apr-23	14
	RA-SP-SDA-S1-FL-10C Review and Approval of FIRE FIGHTING SYSTEM -INSTALLATION DETAILS	12-Apr-23	01-May-23	14
	RA-SP-SDA-S1-FL-10C Review and Approval of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	14-Apr-23	03-May-23	14
	RA-SP-SDA-S1-FL-10C Review and Approval of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	17-Apr-23	05-May-23	14
	Site two	10-Mar-23	05-May-23	46
	Shop drawing submission	10-Mar-23	15-Apr-23	32
	FLS	10-Mar-23	15-Apr-23	32
	RA-SP-SDS-S2-FL-100 Preparation and Submission of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	10-Mar-23	30-Mar-23	18
	RA-SP-SDS-S2-FL-100 Preparation and Submission of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW AND SECTIONS -TUNNELS	13-Mar-23	01-Apr-23	18
	RA-SP-SDS-S2-FL-100 Preparation and Submission of FIRE ALARM -INSTALLATION DETAILS	15-Mar-23	04-Apr-23	18
	RA-SP-SDS-S2-FL-100 Preparation and Submission of FIRE ALARM SYSTEM -PLAN VIEW AND SECTIONS -TUNNEL	17-Mar-23	06-Apr-23	18
	RA-SP-SDS-S2-FL-100 Preparation and Submission of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	20-Mar-23	08-Apr-23	18
	RA-SP-SDS-S2-FL-100 Preparation and Submission of FIRE FIGHTING SYSTEM -INSTALLLATION DETAILS	22-Mar-23	11-Apr-23	18
	RA-SP-SDS-S2-FL-100 Preparation and Submission of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	24-Mar-23	13-Apr-23	18
	RA-SP-SDS-S2-FL-100 Preparation and Submission of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	27-Mar-23	15-Apr-23	18
	Shop drawing Approvals	31-Mar-23	05-May-23	28
	FLS	31-Mar-23	05-May-23	28
	RA-SP-SDA-S2-FL-10C Review and Approval of CENTRAL BATTERY TYPE-EMERGENCY, EXIT LIGHT SYSTEM -TUNNEL SERVICE BUILDING	31-Mar-23	15-Apr-23	14
	RA-SP-SDA-S2-FL-10C Review and Approval of EMERGENCY & EXIT SIGNAGES SYSTEM - PLAN VIEW AND SECTIONS -TUNNELS	03-Apr-23	18-Apr-23	14
	RA-SP-SDA-S2-FL-10C Review and Approval of FIRE ALARM -INSTALLATION DETAILS	05-Apr-23	24-Apr-23	14
	RA-SP-SDA-S2-FL-10C Review and Approval of FIRE ALARM SYSTEM -PLAN VIEW AND SECTIONS -TUNNEL	07-Apr-23	26-Apr-23	14
	RA-SP-SDA-S2-FL-10C Review and Approval of FIRE ALARM SYSTEM -SCHEMATIC FOR TUNNEL SERVICE BUILDING	10-Apr-23	28-Apr-23	14
	RA-SP-SDA-S2-FL-10C Review and Approval of FIRE FIGHTING SYSTEM -INSTALLATION DETAILS	12-Apr-23	01-May-23	14
	RA-SP-SDA-S2-FL-10C Review and Approval of FIRE FIGHTING SYSTEM -TUNNEL SERVICE BUILDING	14-Apr-23	03-May-23	14
	RA-SP-SDA-S2-FL-10C Review and Approval of FIRE FIGHTING SYSTEM -SCHEMATIC FOR TUNNEL	17-Apr-23	05-May-23	14
	Material Submittals Submission and Approval	10-Mar-23	02-May-23	43
	MTS Submission	10-Mar-23	12-Apr-23	29
	Fire Life Safety	10-Mar-23	12-Apr-23	29
	RA-SP-MTS-FLS-1000 Preparation and Submission of Hanger and Support System & Accessories of Firefighting	10-Mar-23	25-Mar-23	14
	RA-SP-MTS-FLS-1001 Preparation and Submission of ERW GI Pipes and Fitting (Grooved and Threaded) for Firefighting System (Above Ground)	13-Mar-23	28-Mar-23	14
	RA-SP-MTS-FLS-1002 Preparation and Submission of GI Conduit & Accessories for Fire Detection & Alarm System and CBS, Emergency & Exit Light	15-Mar-23	30-Mar-23	14
	RA-SP-MTS-FLS-1003 Preparation and Submission of Fire Alarm Cable	16-Mar-23	31-Mar-23	14
	RA-SP-MTS-FLS-1004 Preparation and Submission of Fire Alarm System including panel, Detectors , Modules & Accessories	18-Mar-23	03-Apr-23	14
	RA-SP-MTS-FLS-1005 Preparation and Submission of Linear Heat Detection system including Panel, Cables & Accessories	20-Mar-23	04-Apr-23	14
	RA-SP-MTS-FLS-1007 Preparation and Submission of Firefighting Pump Set	20-Mar-23	04-Apr-23	14
	RA-SP-MTS-FLS-1006 Preparation and Submission of Central Battery system includes Light Fixtures , Dynamic Exit Signs & Signages System for	22-Mar-23	06-Apr-23	14
	RA-SP-MTS-FLS-1008 Preparation and Submission of Firefighting System includes FHC, Breeching Inlet, Fire Extinguisher	24-Mar-23	08-Apr-23	14
	RA-SP-MTS-FLS-1009 Preparation and Submission of Water Spray System includes Deluge Valve , Butterfly Valve & Spray Nozzle	27-Mar-23	11-Apr-23	14
	RA-SP-MTS-FLS-1010 Preparation and Submission of Sprinkler System Includes Sprinklers , ZCV , OS&Y valves	28-Mar-23	12-Apr-23	14
	MTS Approval	27-Mar-23	02-May-23	29
	Fire Life Safety	27-Mar-23	02-May-23	29
	RA-SP-MTA-FLS-1000 Review and Approval of Hanger and Support System & Accessories of Firefighting	27-Mar-23	11-Apr-23	14
	RA-SP-MTA-FLS-1001 Review and Approval of ERW GI Pipes and Fitting (Grooved and Threaded) for Firefighting System (Above Ground)	29-Mar-23	13-Apr-23	14
	RA-SP-MTA-FLS-1002 Review and Approval of GI Conduit & Accessories for Fire Detection & Alarm System and CBS, Emergency & Exit Lighting Syst	31-Mar-23	15-Apr-23	14
	RA-SP-MTA-FLS-1003 Review and Approval of Fire Alarm Cable	01-Apr-23	17-Apr-23	14
	RA-SP-MTA-FLS-1004 Review and Approval of Fire Alarm System including panel, Detectors , Modules & Accessories	04-Apr-23	19-Apr-23	14
	RA-SP-MTA-FLS-1005 Review and Approval of Linear Heat Detection system including Panel, Cables & Accessories	05-Apr-23	24-Apr-23	14
	RA-SP-MTA-FLS-1007 Review and Approval of Firefighting Pump Set	05-Apr-23	24-Apr-23	14
	RA-SP-MTA-FLS-1006 Review and Approval of Central Battery system includes Light Fixtures , Dynamic Exit Signs & Signages System for Tunnel a	07-Apr-23	26-Apr-23	14
	RA-SP-MTA-FLS-1008 Review and Approval of Firefighting System includes FHC, Breeching Inlet, Fire Extinguisher	10-Apr-23	28-Apr-23	14
	RA-SP-MTA-FLS-1009 Review and Approval of Water Spray System includes Deluge Valve , Butterfly Valve & Spray Nozzle	12-Apr-23	01-May-23	14
	RA-SP-MTA-FLS-1010 Review and Approval of Sprinkler System Includes Sprinklers , ZCV , OS&Y valves	13-Apr-23	02-May-23	14
	Method Statement Submission and Approval	10-Mar-23	18-Apr-23	34
	MOS Submission	10-Mar-23	01-Apr-23	20
	FLS	10-Mar-23	01-Apr-23	20
	RA-SP-MOS-FLS-1000 Submission of Method Statement for Embedded Firefighting Pipeworks inside Tunnel	10-Mar-23	25-Mar-23	14
	RA-SP-MOS-FLS-1001 Method Statement for Installation of Fire Pumps , Diesel Pumps Jockey Pumps and its associated Panels & Fuel tanks	13-Mar-23	28-Mar-23	14
	RA-SP-MOS-FLS-1002 Submission of Method Statement for Installation of Fire Alarm and Detection System with all Components	15-Mar-23	30-Mar-23	14
	RA-SP-MOS-FLS-1003 Method Statement for Installation of Fire Hydrants , Fire Hose Cabinets , Breeching Inlets , Fire Extinguishers	17-Mar-23	01-Apr-23	14
	MOS Approval	27-Mar-23	18-Apr-23	20
	FLS	27-Mar-23	18-Apr-23	20
	RA-SP-MOA-FLS-1000 Review and approval of Method Statement for Firefighting Pipeworks	27-Mar-23	11-Apr-23	14
	RA-SP-MOA-FLS-1001 Review and approval of Method Statement for Installation of Fire Pumps , Diesel Pumps Jockey Pumps	29-Mar-23	13-Apr-23	14
	RA-SP-MOA-FLS-1002 Review and approval of Method Statement for Installation of Fire Alarm and Detection System with all Components	31-Mar-23	15-Apr-23	14

VARIOUS CONSTRUCTION WORKS IN HAIL & QURAYYA -MEP BASELINE PROGRAM OF WORKS

Activity ID	Activity Name	Start	Finish	Original Duration
	RA-SP-MOA-FLS-1003 Review and approval of Method Statement for Installation of Fire Hydrants , Fire Hose Cabinets , Fire Extinguishers	03-Apr-23	18-Apr-23	14
	Procurement and Delivery of Materials	12-Apr-23	10-Sep-23	152
	Material Order (LPO)	12-Apr-23	13-May-23	25
	General Materials	12-Apr-23	02-May-23	15
	Fire Life Safety	12-Apr-23	02-May-23	15
	RA-SP-GPO-FLS-1000 Ordering of Hanger and Support System & Accessories of Firefighting	12-Apr-23	26-Apr-23	10
	RA-SP-GPO-FLS-1001 Ordering of ERW GI Pipes and Fitting (Grooved and Threaded) for Firefighting System (Above Ground)	14-Apr-23	28-Apr-23	10
	RA-SP-GPO-FLS-1002 Ordering of GI Conduit & Accessories for Fire Detection & Alarm System and CBS, Emergency & Exit Lighting System	17-Apr-23	01-May-23	10
	RA-SP-GPO-FLS-1003 Ordering of Fire Alarm Cable	18-Apr-23	02-May-23	10
	Long lead Materials	24-Apr-23	13-May-23	18
	Fire Life Safety	24-Apr-23	13-May-23	18
	RA-SP-LPO-FLS-1004 Ordering of Fire Alarm System including panel, Detectors , Modules & Accessories	24-Apr-23	04-May-23	10
	RA-SP-LPO-FLS-1005 Ordering of Linear Heat Detection system including Panel, Cables & Accessories	25-Apr-23	05-May-23	10
	RA-SP-LPO-FLS-1007 Ordering of Firefighting Pump Set	25-Apr-23	05-May-23	10
	RA-SP-LPO-FLS-1006 Ordering of Central Battery system includes Light Fixtures , Dynamic Exit Signs & Signages System for Tunnel and TSB	27-Apr-23	08-May-23	10
	RA-SP-LPO-FLS-1008 Ordering of Firefighting System includes FHC, Breaching Inlet, Fire Extinguisher	29-Apr-23	10-May-23	10
	RA-SP-LPO-FLS-1009 Ordering of Water Spray System includes Deluge Valve , Butterfly Valve & Spray Nozzle	02-May-23	12-May-23	10
	RA-SP-LPO-FLS-1010 Ordering of Sprinkler System Includes Sprinklers , ZCV , OS & Y valves	03-May-23	13-May-23	10
	Manufacturing and delivery of Materials	27-Apr-23	10-Sep-23	137
	General Materials	27-Apr-23	27-May-23	31
	Fire Life Safety	27-Apr-23	27-May-23	31
	RA-SP-GDM-FLS-1000 Manufacturing and delivery of Hanger and Support System & Accessories of Firefighting	27-Apr-23	21-May-23	25
	RA-SP-GDM-FLS-1001 Manufacturing and delivery of ERW GI Pipes and Fitting (Grooved and Threaded) for Firefighting System (Above Ground)	29-Apr-23	23-May-23	25
	RA-SP-GDM-FLS-1002 Manufacturing and delivery of GI Conduit & Accessories for Fire Detection & Alarm System and CBS, Emergency & Exit Light	02-May-23	26-May-23	25
	RA-SP-GDM-FLS-1003 Manufacturing and delivery of Fire Alarm Cable	03-May-23	27-May-23	25
	Long lead Materials	05-May-23	10-Sep-23	129
	Fire Life Safety	05-May-23	10-Sep-23	129
	RA-SP-LDM-FLS-1004 Manufacturing and delivery of Fire Alarm System including panel , Detectors , Modules & Accessories	05-May-23	02-Aug-23	90
	RA-SP-LDM-FLS-1005 Manufacturing and delivery of Linear Heat Detection system including Panel, Cables & Accessories	06-May-23	03-Aug-23	90
	RA-SP-LDM-FLS-1006 Manufacturing and delivery of Central Battery system includes Light Fixtures , Dynamic Exit Signs & Signages System for	09-May-23	06-Aug-23	90
	RA-SP-LDM-FLS-1008 Manufacturing and delivery of Fire fighting System includes FHC, Breaching Inlet, Fire Extinguisher	11-May-23	08-Aug-23	90
	RA-SP-LDM-FLS-1007 Manufacturing and delivery of Firefighting Pump Set	06-May-23	02-Sep-23	120
	RA-SP-LDM-FLS-1009 Manufacturing and delivery of Water Spray System includes Deluge Valve , Butterfly Valve & Spray Nozzle	13-May-23	09-Sep-23	120
	RA-SP-LDM-FLS-1010 Manufacturing and delivery of Sprinkler System Includes Sprinklers , ZCV , OS & Y valves	14-May-23	10-Sep-23	120
	Construction Works	26-Jun-23	05-Dec-23	132
	Site One	15-Aug-23	04-Dec-23	93
	External Works	25-Aug-23	04-Dec-23	84
	Tunnel Service building (TSB 1A)	25-Aug-23	16-Oct-23	44
	MEP 1st Fix	25-Aug-23	07-Sep-23	12
	FLS	25-Aug-23	07-Sep-23	12
	Fire Fighting	25-Aug-23	07-Sep-23	12
	SP-S1-CON-TSB Support installation for Fire Fighting pipes (TSB 1A)	25-Aug-23	07-Sep-23	12
	FA and CBS	25-Aug-23	07-Sep-23	12
	SP-S1-CON-TSB Conduit installation for FA and CBS system (TSB 1A)	25-Aug-23	07-Sep-23	12
	MEP 2nd Fix	08-Sep-23	13-Oct-23	30
	FLS	08-Sep-23	13-Oct-23	30
	Fire Fighting	08-Sep-23	13-Oct-23	30
	SP-S1-CON-TSB Fire Fighting Pipe installation (TSB 1A)	08-Sep-23	29-Sep-23	18
	SP-S1-CON-TSB Fire Fighting Pump installation and connection (TSB 1A)	30-Sep-23	13-Oct-23	12
	FA and CBS	08-Sep-23	29-Sep-23	18
	SP-S1-CON-TSB Wiring for FA and CB System (TSB 1A)	08-Sep-23	29-Sep-23	18
	MEP Final Fix	30-Sep-23	16-Oct-23	14
	FLS	30-Sep-23	16-Oct-23	14
	FA and CBS	30-Sep-23	16-Oct-23	14
	SP-S1-CON-TSB FA & CBS Panel Installation (TSB 1A)	30-Sep-23	16-Oct-23	14
	SP-S1-CON-TSB FLS Detectors, Emergency light installation (TSB 1A)	30-Sep-23	16-Oct-23	14
	Fire Fighting	30-Sep-23	16-Oct-23	14
	SP-S1-CON-TSB Installation of FM 200, Sprinklers, Fire Extinguisher (TSB 1A)	30-Sep-23	16-Oct-23	14
	Chiller yard works	11-Oct-23	04-Dec-23	45
	1st & 2nd Fix	11-Oct-23	13-Nov-23	29
	FLS	11-Oct-23	13-Nov-23	29
	Fire Fighting	11-Oct-23	24-Oct-23	12
	SP-S1-CON-CH- Fire Fighting Pipe installation	11-Oct-23	24-Oct-23	12
	FA and CB System	14-Oct-23	13-Nov-23	26
	SP-S1-CON-CH- Conduit installation for FA and CBS system	14-Oct-23	30-Oct-23	14
	SP-S1-CON-CH- Wiring for FA and CB System	31-Oct-23	13-Nov-23	12
	Final Fix	25-Oct-23	04-Dec-23	33
	FLS	25-Oct-23	04-Dec-23	33
	Fire Fighting	25-Oct-23	09-Nov-23	14
	SP-S1-CON-CH- Installation of FM 200, Sprinklers, Fire Extinguisher	25-Oct-23	09-Nov-23	14
	FA and CB System	14-Nov-23	04-Dec-23	16
	SP-S1-CON-CH- FLS Detectors, Emergency light installation	14-Nov-23	04-Dec-23	16
	Facility (01) & Facility (08)-(Main Tube + Secondary Tube)	15-Aug-23	12-Oct-23	50
	Main Tunnel	15-Aug-23	12-Oct-23	50
	1st & 2nd Fix	15-Aug-23	25-Sep-23	36
	FLS	15-Aug-23	25-Sep-23	36
	Fire Fighting	15-Aug-23	19-Sep-23	31
	SP-S1-CON-TN- Fire Fighting pipe Support fixing	15-Aug-23	25-Aug-23	10
	SP-S1-CON-TN- Fire fighting pipes and valves installation with testing	26-Aug-23	19-Sep-23	21
	FA and CBS	15-Aug-23	25-Sep-23	36

VARIOUS CONSTRUCTION WORKS IN HAIL & QURAYYA -MEP BASELINE PROGRAM OF WORKS

Activity ID	Activity Name	Start	Finish	Original Duration
	SP-S1-CON-TN- GI Conduiting for FA and CB System	15-Aug-23	04-Sep-23	18
	SP-S1-CON-TN- Cable pulling for FA and CBS System	05-Sep-23	25-Sep-23	18
	Final Fix			
	FLS			
	Fire Fighting	20-Sep-23	06-Oct-23	14
	SP-S1-CON-TN- FHC,Sprinklers, Sounder, MCP installation	20-Sep-23	06-Oct-23	14
	FA and CBS	26-Sep-23	12-Oct-23	14
	SP-S1-CON-TN- FLS Detectors, Emergency light installation	26-Sep-23	12-Oct-23	14
	Stores S1 to S40			
	MEP 1st Fix			
	FLS			
	Fire Fighting	15-Aug-23	28-Aug-23	12
	SP-S1-CON-ST-1 Support installation for Fire Fighting pipes	15-Aug-23	28-Aug-23	12
	FA and CBS	15-Aug-23	28-Aug-23	12
	SP-S1-CON-ST-1 Conduit installation for FA and CBS system	15-Aug-23	28-Aug-23	12
	MEP 2nd Fix			
	FLS			
	Fire Fighting	29-Aug-23	18-Sep-23	18
	SP-S1-CON-ST-1 Fire Fighting Pipe installation	29-Aug-23	18-Sep-23	18
	FA and CBS	29-Aug-23	18-Sep-23	18
	SP-S1-CON-ST-1 Wiring for FA and CB System	29-Aug-23	18-Sep-23	18
	MEP Final Fix			
	FLS			
	FA and CBS	19-Sep-23	05-Oct-23	14
	SP-S1-CON-ST-1 FLS Detectors, Emergency light installation	19-Sep-23	05-Oct-23	14
	Fire Fighting	19-Sep-23	05-Oct-23	14
	SP-S1-CON-ST-1 Installation of FM 200, Sprinklers, Fire Extinguisher	19-Sep-23	05-Oct-23	14
	Facility (02) & Hanger building (1 No)			
	MEP 1st Fix			
	FLS			
	Fire Fighting	25-Aug-23	07-Sep-23	12
	SP-S1-CON-HNB-1 Support installation for Fire Fighting pipes	25-Aug-23	07-Sep-23	12
	FA and CBS	25-Aug-23	07-Sep-23	12
	SP-S1-CON-HNB-1 Conduit installation for FA and CBS system	25-Aug-23	07-Sep-23	12
	MEP 2nd Fix			
	FLS			
	Fire Fighting	08-Sep-23	29-Sep-23	18
	SP-S1-CON-HNB-1 Fire Fighting Pipe installation	08-Sep-23	29-Sep-23	18
	FA and CBS	08-Sep-23	29-Sep-23	18
	SP-S1-CON-HNB-1 Wiring for FA and CB System	08-Sep-23	29-Sep-23	18
	MEP Final Fix			
	FLS			
	FA and CBS	30-Sep-23	16-Oct-23	14
	SP-S1-CON-HNB-1 FLS Detectors, Emergency light installation	30-Sep-23	16-Oct-23	14
	Fire Fighting	30-Sep-23	16-Oct-23	14
	SP-S1-CON-HNB-1 Installation of FM 200, Sprinklers, Fire Extinguisher	30-Sep-23	16-Oct-23	14
	Site Two			
	External Works			
	Tunnel Service building (TSB 2A)-Tunnel 2			
	MEP 1st Fix			
	FLS			
	Fire Fighting	20-Sep-23	10-Nov-23	44
	SP-S2-CON-TSB Support installation for Fire Fighting pipes (TSB 2A)	20-Sep-23	04-Oct-23	12
	FA and CBS	20-Sep-23	04-Oct-23	12
	SP-S2-CON-TSB Conduit installation for FA and CBS system (TSB 2A)	20-Sep-23	04-Oct-23	12
	MEP 2nd Fix			
	FLS			
	Fire Fighting	05-Oct-23	08-Nov-23	30
	SP-S2-CON-TSB Fire Fighting Pipe installation (TSB 2A)	05-Oct-23	08-Nov-23	30
	SP-S2-CON-TSB Fire Fighting Pump installation and connection (TSB 2A)	26-Oct-23	08-Nov-23	12
	FA and CBS	05-Oct-23	25-Oct-23	18
	SP-S2-CON-TSB Wiring for FA and CB System (TSB 2A)	05-Oct-23	25-Oct-23	18
	MEP Final Fix			
	FLS			
	FA and CBS	26-Oct-23	10-Nov-23	14
	SP-S2-CON-TSB FA & CBS Panel Installation (TSB 2A)	26-Oct-23	10-Nov-23	14
	SP-S2-CON-TSB FLS Detectors, Emergency light installation (TSB 2A)	26-Oct-23	10-Nov-23	14
	Fire Fighting	26-Oct-23	10-Nov-23	14
	SP-S2-CON-TSB Installation of FM 200, Sprinklers, Fire Extinguisher (TSB 2A)	26-Oct-23	10-Nov-23	14
	Tunnel Service building (TSB 2B)-Tunnel 1			
	MEP 1st Fix			
	FLS			
	Fire Fighting	20-Sep-23	04-Oct-23	12
	SP-S2-CON-TSB Support installation for Fire Fighting pipes (TSB 2B)	20-Sep-23	04-Oct-23	12
	FA and CBS	20-Sep-23	04-Oct-23	12
	SP-S2-CON-TSB Conduit installation for FA and CBS system (TSB 2B)	20-Sep-23	04-Oct-23	12
	MEP 2nd Fix			
	FLS			
	Fire Fighting	05-Oct-23	08-Nov-23	30
	SP-S2-CON-TSB Fire Fighting Pipe installation (TSB 2B)	05-Oct-23	08-Nov-23	30

VARIOUS CONSTRUCTION WORKS IN HAIL & QURAYYA -MEP BASELINE PROGRAM OF WORKS

Activity ID	Activity Name	Start	Finish	Original Duration
	SP-S2-CON-TSB Fire Fighting Pump installation and connection (TSB 2B)	26-Oct-23	08-Nov-23	12
	FA and CBS	05-Oct-23	25-Oct-23	18
	SP-S2-CON-TSB Wiring for FA and CB System (TSB 2B)	05-Oct-23	25-Oct-23	18
	MEP Final Fix	26-Oct-23	10-Nov-23	14
	FLS	26-Oct-23	10-Nov-23	14
	FA and CBS	26-Oct-23	10-Nov-23	14
	SP-S2-CON-TSB FA & CBS Panel Installation (TSB 2B)	26-Oct-23	10-Nov-23	14
	SP-S2-CON-TSB FLS Detectors, Emergency light installation (TSB 2B)	26-Oct-23	10-Nov-23	14
	Fire Fighting	26-Oct-23	10-Nov-23	14
	SP-S2-CON-TSB Installation of FM 200, Sprinklers, Fire Extinguisher (TSB 2B)	26-Oct-23	10-Nov-23	14
	Chiller yard works	12-Oct-23	05-Dec-23	45
	1st & 2nd Fix	12-Oct-23	14-Nov-23	29
	FLS	12-Oct-23	14-Nov-23	29
	Fire Fighting	12-Oct-23	25-Oct-23	12
	SP-S2-CON-CH- Fire Fighting Pipe installation	12-Oct-23	25-Oct-23	12
	FA and CB System	16-Oct-23	14-Nov-23	26
	SP-S2-CON-CH- Conduit installation for FA and CBS system	16-Oct-23	31-Oct-23	14
	SP-S2-CON-CH- Wiring for FA and CB System	01-Nov-23	14-Nov-23	12
	Final Fix	26-Oct-23	05-Dec-23	33
	FLS	26-Oct-23	05-Dec-23	33
	Fire Fighting	26-Oct-23	10-Nov-23	14
	SP-S2-CON-CH- Installation of FM 200, Sprinklers, Fire Extinguisher	26-Oct-23	10-Nov-23	14
	FA and CB System	15-Nov-23	05-Dec-23	16
	SP-S2-CON-CH- FLS Detectors, Emergency light installation	15-Nov-23	05-Dec-23	16
	Facility (01) & Facility (08)(Main Tube + Secondary Tube)	26-Jun-23	26-Sep-23	75
	Main Tunnel 1 & 2	26-Jun-23	26-Sep-23	75
	1st & 2nd Fix	26-Jun-23	11-Aug-23	36
	FLS	26-Jun-23	11-Aug-23	36
	Fire Fighting	26-Jun-23	05-Aug-23	31
	SP-S2-CON-TN- Fire Fighting pipe Support fixing	26-Jun-23	11-Jul-23	10
	SP-S2-CON-TN- Fire fighting pipes and valves installation with testing	12-Jul-23	05-Aug-23	21
	FA and CBS	26-Jun-23	11-Aug-23	36
	SP-S2-CON-TN- GI Conduiting for FA and CB System	26-Jun-23	21-Jul-23	18
	SP-S2-CON-TN- Cable pulling for FA and CBS System	22-Jul-23	11-Aug-23	18
	Final Fix	12-Aug-23	26-Sep-23	39
	FLS	12-Aug-23	26-Sep-23	39
	Fire Fighting	11-Sep-23	26-Sep-23	14
	SP-S2-CON-TN- FHC, Sprinklers, Sounder, MCP installation	11-Sep-23	26-Sep-23	14
	FA and CBS	12-Aug-23	28-Aug-23	14
	SP-S2-CON-TN- FLS Detectors, Emergency light installation	12-Aug-23	28-Aug-23	14
	Stores S1 to S24	26-Jun-23	26-Sep-23	75
	MEP 1st Fix	26-Jun-23	13-Jul-23	12
	FLS	26-Jun-23	13-Jul-23	12
	Fire Fighting	26-Jun-23	13-Jul-23	12
	SP-S2-CON-ST-1 Support installation for Fire Fighting pipes	26-Jun-23	13-Jul-23	12
	FA and CBS	26-Jun-23	13-Jul-23	12
	SP-S2-CON-ST-1 Conduit installation for FA and CBS system	26-Jun-23	13-Jul-23	12
	MEP 2nd Fix	14-Jul-23	04-Aug-23	18
	FLS	14-Jul-23	04-Aug-23	18
	Fire Fighting	14-Jul-23	04-Aug-23	18
	SP-S2-CON-ST-1 Fire Fighting Pipe installation	14-Jul-23	04-Aug-23	18
	FA and CBS	14-Jul-23	04-Aug-23	18
	SP-S2-CON-ST-1 Wiring for FA and CB System	14-Jul-23	04-Aug-23	18
	MEP Final Fix	07-Aug-23	26-Sep-23	44
	FLS	07-Aug-23	26-Sep-23	44
	FA and CBS	07-Aug-23	22-Aug-23	14
	SP-S2-CON-ST-1 FLS Detectors, Emergency light installation	07-Aug-23	22-Aug-23	14
	Fire Fighting	11-Sep-23	26-Sep-23	14
	SP-S2-CON-ST-1 Installation of FM 200, Sprinklers, Fire Extinguisher	11-Sep-23	26-Sep-23	14
	Facility (03) & Hanger building (2 Nos)	20-Sep-23	10-Nov-23	44
	For Tunnel 1	20-Sep-23	10-Nov-23	44
	MEP 1st Fix	20-Sep-23	04-Oct-23	12
	FLS	20-Sep-23	04-Oct-23	12
	Fire Fighting	20-Sep-23	04-Oct-23	12
	SP-S2-CON-HNI Support installation for Fire Fighting pipes	20-Sep-23	04-Oct-23	12
	FA and CBS	20-Sep-23	04-Oct-23	12
	SP-S2-CON-HNI Conduit installation for FA and CBS system	20-Sep-23	04-Oct-23	12
	MEP 2nd Fix	05-Oct-23	25-Oct-23	18
	FLS	05-Oct-23	25-Oct-23	18
	Fire Fighting	05-Oct-23	25-Oct-23	18
	SP-S2-CON-HNI Fire Fighting Pipe installation	05-Oct-23	25-Oct-23	18
	FA and CBS	05-Oct-23	25-Oct-23	18
	SP-S2-CON-HNI Wiring for FA and CB System	05-Oct-23	25-Oct-23	18
	MEP Final Fix	26-Oct-23	10-Nov-23	14
	FLS	26-Oct-23	10-Nov-23	14
	FA and CBS	26-Oct-23	10-Nov-23	14
	SP-S2-CON-HNI FLS Detectors, Emergency light installation	26-Oct-23	10-Nov-23	14
	Fire Fighting	26-Oct-23	10-Nov-23	14
	SP-S2-CON-HNI Installation of FM 200, Sprinklers, Fire Extinguisher	26-Oct-23	10-Nov-23	14
	For Tunnel 2	20-Sep-23	10-Nov-23	44

VARIOUS CONSTRUCTION WORKS IN HAIL & QURAYYA -MEP BASELINE PROGRAM OF WORKS

Activity ID	Activity Name	Start	Finish	Original Duration
	MEP 1st Fix			
	FLS			
	Fire Fighting			
	SP-S2-CON-HNI Support installation for Fire Fighting pipes	20-Sep-23	04-Oct-23	12
	FA and CBS			
	SP-S2-CON-HNI Conduit installation for FA and CBS system	20-Sep-23	04-Oct-23	12
	MEP 2nd Fix			
	FLS			
	Fire Fighting			
	SP-S2-CON-HNI Fire Fighting Pipe installation	05-Oct-23	25-Oct-23	18
	FA and CBS			
	SP-S2-CON-HNI Wiring for FA and CB System	05-Oct-23	25-Oct-23	18
	MEP Final Fix			
	FLS			
	FA and CBS			
	SP-S2-CON-HNI FLS Detectors, Emergency light installation	26-Oct-23	10-Nov-23	14
	Fire Fighting			
	SP-S2-CON-HNI Installation of FM 200, Sprinklers, Fire Extinguisher	26-Oct-23	10-Nov-23	14
	Facility (04)- Guard Room			
	MEP 1st Fix			
	FLS			
	Fire Fighting			
	SP-S2-CON-GR-10 Support installation for Fire Fighting pipes	20-Sep-23	04-Oct-23	12
	FA and CBS			
	SP-S2-CON-GR-10 Conduit installation for FA and CBS system	20-Sep-23	04-Oct-23	12
	MEP 2nd Fix			
	FLS			
	Fire Fighting			
	SP-S2-CON-GR-10 Fire Fighting Pipe installation	05-Oct-23	25-Oct-23	18
	FA and CBS			
	SP-S2-CON-GR-10 Wiring for FA and CB System	05-Oct-23	25-Oct-23	18
	MEP Final Fix			
	FLS			
	FA and CBS			
	SP-S2-CON-GR-10 FLS Detectors, Emergency light installation	26-Oct-23	10-Nov-23	14
	Fire Fighting			
	SP-S2-CON-GR-10 Installation of FM 200, Sprinklers, Fire Extinguisher	26-Oct-23	10-Nov-23	14
	Testing and Commissioning			
	Site One			
	SP-S1-TC-1000 FLS System T&C	28-Dec-23	18-Jan-24	18
	Site Two			
	SP-S2-TC-1001 FLS System T&C	13-Jan-24	02-Feb-24	18
		13-Jan-24	02-Feb-24	18