SECTION  – gypsum board

SPEC NOTE: This Section is for Interior and core and shell Projects. Type X 5/8-inch gypsum board and mineral fibre acoustical insulation is specified separately in 09 29 13 – Type X Gypsum Board.

Gypsum shaftwall assemblies are specified in “Gypsum Board Shaft-Wall Assemblies.”

1. GENERAL
   1. summary
      1. This Section includes requirement for supply and installation of components required for a complete wall and ceiling assembly with proprietary components as follows:

SPEC NOTE: Edit items from the following lists (panels and accessories) to reflect items required on the project. Delete or add all that apply.

* + - 1. Gypsum Board Panels: Supply and installation of the following:
         1. Standard Gypsum Wallboard.
         2. Gypsum Ceiling Board.
         3. Tile Backer Board.
      2. Installation of Type X Gypsum Board Panels.
      3. Gypsum Wallboard Accessories:
         1. Security Mesh.
         2. Acoustic Liner Board.
         3. Installation of mineral fibre acoustical Insulation.
         4. Screws, tape, joint compound, and all other accessories required for gypsum board ceiling and wall partitions.
         5. Access Panels.
    1. Related Requirements:
       1. Section 09 29 13 – Type X Gypsum Board, for Type X 5/8 inch gypsum board and mineral fibre acoustical insulation products to be installed under Section 09 29 00 – Gypsum Board.
  1. REFERENCE STANDARDS
     1. American Society for Testing and Materials International (ASTM):
        1. ASTM C 11-10a, Standard Terminology Relating to Gypsum and Related Building Materials.
        2. ASTM C 473-12, Standard Test Methods for Physical Testing of Gypsum Panel Products.
        3. ASTM C 475/C475M-12, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
        4. ASTM C 514-04(2009) e1, Standard Specifications for Nails for the Application of Gypsum Board.
        5. ASTM C 665-12, Standard Specification for Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
        6. ASTM C 834-10, Standard Specification for Latex Sealants.
        7. ASTM C 840-11, Standard Specification for Application and Finishing of Gypsum Board.
        8. ASTM C 841-03(2008) e1, Standard Specification for Installation of Interior Lathing and Furring.
        9. ASTM C 954-11, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033" to 0.112" in Thickness.
        10. ASTM C 955-11c, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
        11. ASTM C 1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
        12. ASTM C 1047-10a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
        13. ASTM C 1177/C 1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
        14. ASTM C 1178/C 1178M-11, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
        15. ASTM C 1186-08, Standard Specification for Flat Fiber-Cement Sheets.
        16. ASTM C 1278/C 1278M-07a(2011), Standard Specification for Fiber-Reinforced Gypsum Panel.
        17. ASTM C 1325-08b, Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units.
        18. ASTM C 1396/C 1396M-11, Standard Specification for Gypsum Board.
        19. ASTM C 1658/C 1658M-12, Standard Specification for Glass Mat Gypsum Panels.
        20. ASTM D 3273-12, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
        21. ASTM D 3274-09, Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.
        22. ASTM D 3678-97(2008) e1, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Interior-Profile Extrusions.
     2. Gypsum Association (GA):
        1. GA-214-10, Recommended Levels of Gypsum Board Finish.
        2. GA-216-10, Application and Finishing of Gypsum Board.
        3. GA-231-06, Assessing Water Damage to Gypsum Board.
        4. GA-238-03, Guidelines for the Prevention of Mold Growth on Gypsum Board.
  2. QUALITY ASSURANCE
     1. Contractor executing work of this Section shall have a minimum of five (5) years continuous Canadian experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.
     2. Environmental Product Declarations: Obtain products with the following publicly available, third-party verified Type III Environmental Product Declaration (EPDs) in accordance with Section 01 81 33 – Sustainable Design Requirements - Embodied Carbon:
        1. Joint compound: Industry-wide or Product-Specific EPDs.
  3. submittals
     1. Sustainable Design Submittals: Refer to Division 01 Section 01 81 33 – Sustainable Design Requirements.
     2. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
     3. Shop Drawings: Submit shop drawings showing the design, construction and relevant details of furring, enclosures and partitions which require a fire rating.
     4. Product Data: Submit manufacturer's current technical literature for each component.
     5. Samples: Supply for Consultant's review, if requested, samples of the following:
        1. Board: Submit sample of each panel product specified, 150mm (6") square.
        2. Trim: Submit sample of each type of trim specified, 305mm (12") long.
        3. Texture: Submit sample, 305mm (12”) square of textured coated gypsum board.
     6. Quality Assurance Submittals:
        1. Design Data, Test Reports: Provide manufacturer's test reports indicating product compliance with indicated requirements.
        2. Manufacturer's Instructions: Provide manufacturer's written installation instructions.
  4. Informational Submittals

The paragraph below aligns with edits made in January of 2023 to Gensler's master specifications for our GC3 initiative. This requires that contractors complete an EPD Reporting Form, referenced in 01 81 33 – Sustainable Design Requirements - Embodied Carbon disclosing (checking a box) if an EPD exists for the product, and to provide the EPD.

* + 1. Environmental Product Declaration (EPD) Disclosure Submittals: Completed Environmental Product Declaration Reporting Form in accordance with Section 01 81 33 – Sustainable Design Requirements - Embodied Carbon for the following product types in this Section:
       1. Standard Gypsum Wallboard.
       2. Gypsum Ceiling Board.
       3. Tile Backer Board.
  1. DELIVERY, STORAGE, HANDLING AND protection
     1. Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, enclosed, under cover storage location. Do not load any area beyond the design limits.
     2. Materials shall be carefully checked, unloaded, stored, and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.
     3. Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact, in accordance with GA-238 and manufacturer's recommendations.
     4. Protect bagged products from excessive moisture or wetting. Store metal component sections in crates to prevent damage to material. Do not use bent or deformed material.
  2. PROJECT CONDITIONS
     1. Establish and maintain environmental conditions for application and finishing gypsum wallboard to comply with ASTM C 840 and in accordance with manufacturer's written instructions.
     2. In cold weather (outdoor temperatures less than 13 deg. C, controlled heat in the range of 13 deg. C to 21 deg. C must be provided. This heat must be maintained both day and night, 24 hours before, during, and after entire gypsum board joint finishing and until the permanent heating system is in operation or the building is occupied. Minimum temperature of 10 deg. C shall be maintained during gypsum board application.
     3. Ventilate building spaces to remove excess moisture and humidity during the drying process. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

1. products
   1. MATERIALS – WALLBOARD

SPEC NOTE: Edit the following paragraphs in 2.1 to reflect gypsum types that are required on the Project.

SPEC NOTE: Please note that there are many types of gypsum board which are not identified in this Section, so please consult with the Spec leader if there is a type of gypsum board that is required on the Project but not listed in 2.1 below.

* + 1. Standard Gypsum Wallboard:
       1. Conforming to ASTM C 1396, ivory paper faced, tapered edges, 1220mm (48") wide sheets of maximum practical lengths to minimize end joints.
          1. Sheetrock Brand Gypsum Panels by CGC Inc.
          2. ProRoc Regular by CertainTeed.
          3. ToughRock Gypsum Wallboard by Georgia-Pacific Canada.
    2. Gypsum Ceiling Board:
       1. Sag Resistant Gypsum Board: Meeting requirements of ASTM C 1396M, ceiling board manufactured to have more sag resistance than regular type gypsum board with long edges tapered, and as follows:
          1. Location: Ceiling surfaces.
          2. Acceptable Materials:

Sheetrock Interior Ceiling Board by CGC Inc.

Tough Rock CD Ceiling Board by Georgia Pacific Canada.

ProRoc Interior Ceiling Board by CertainTeed.

* + 1. Tile Backer Board:
       1. Glass Mat Water Resistant Gypsum Backer Board: Manufactured in accordance with ASTM C 1178 and C 1658 to produce greater resistance to water penetration and to provide improved surface bonding characteristics for ceramic tile than standard gypsum board:
          1. Location: Substrate for ceramic tile.
          2. Acceptable Materials:

Fiberock Aqua Tough Tile Backerboard by CGC Inc.

Diamondback Tile Backer by CertainTeed.

GlasRoc Tile Backer by Georgia-Pacific Canada.

* 1. ACCESSORIES
     1. Ceiling / Baffle Insulation Board:
        1. Faced, non-combustible, rigid, mineral wool fire rated insulation board to ASTM C 612, Type IVB.
           1. Non-combustibility: To CAN/ULC S114.
           2. Size: 610mm x 1219mm.
           3. Thickness: 50mm, unless otherwise indicated on the Drawings.
           4. Facer: Aluminum foil with fiberglass (RFF) reinforcement to ASTM.
           5. Location: Baffle Insulation.
           6. Basis of Design Material: ROCKBOARD 60 with RFF Facer by Rockwool Inc.
     2. Concrete Anchors:
        1. Self-drilling tie wire anchors, "Red-Head No. T-32" by Phillips Drill Company, Division of ITT Industries of Canada Ltd., or approved equal.
     3. Concrete Inserts:
        1. Hot-dip galvanized "turtle back" type concrete inserts to suit conditions as approved by Consultant, by Acrow-Richmond National Concrete Accessories, Division of Premetalco Inc., or approved equal.
     4. Gypsum Wallboard Accessories:
        1. In general, gypsum wallboard accessories shall conform to ASTM C 1047.
        2. Corner Beads:
           1. Made from galvanized steel sheet conforming to ASTM A653, minimum 0.0179" (25 gauge). Minimum width of flanges 28mm for 13mm (1-1/8" for 1/2") thick wallboard and 32mm for 16mm (1-1/4" for 5/8") thick wallboard.
        3. Casing Beads:
           1. Made from galvanized steel sheet conforming to ASTM A 653, minimum 30 gauge, U-shaped designed for finishing with joint compound.
        4. Control Joints:
           1. Made from galvanized sheet steel conforming to ASTM A 653, minimum 0.0179" (25 gauge), or roll-formed zinc-alloy to resist corrosion, with expansion joint material perforated flanges.

'Zinc Control Joint No. 093' by CGC Inc., or approved equal.

* + - 1. Reveals:
         1. Galvanized sheet steel conforming to ASTM A653, minimum 0.0179" (25 gauge), in profiles as indicated on Drawings.
    1. Wallboard Screws:
       1. Corrosion resistant, self-drilling, self-tapping gypsum wallboard screws conforming to ASTM C 1002 (Type S) and ASTM C 954 (Type S-12), 25mm (1") long No. 6 for single layer application, 41mm (1-5/8") long No. 7 for double layer application.
       2. At fire rated construction, type and size of wallboard screw shall be same as used in fire-rating test.
    2. Joint Compound for Interior Gypsum Board:
       1. Conforming to ASTM C 475 and as recommended by gypsum wallboard, fire-rated gypsum wallboard and exterior wallboard manufacturers to suit conditions.
    3. Joint Compound for Tile Backing Panels:
       1. Gypsum based tile backing board: Use setting type taping and setting type, sandable topping compounds.
    4. Resilient Sponge Tape:
       1. Closed cell neoprene sponge type tape with self-sticking adhesive on one side. 'Permastik 122X' by Jacobs and Thompson Ltd., or foamed vinyl type tape, 'Arnofoam' by Arno Adhesive Tape Incorporated.
    5. Adhesive:
       1. Conforming to CGSB 71-GP-25M, and as recommended by manufacturer and compatible with contacted surfaces.
    6. Building Paper:
       1. No. 15 asphalt building paper conforming to CAN/CGSB-51.32-M.

SPEC NOTE: Delete the following if security mesh isn't required on the Project.

* + 1. Security Mesh:
       1. 3/4" x 10 gauge expanded metal mesh as detailed and required.
       2. Security Mesh Fasteners: Suitable self-drilling, self-tapping, corrosion-resistant metal fasteners and washers approved by Consultant.
    2. Access Panels:

SPEC NOTE: Select which of the following types of access panels. First option is for standard finish access panels. The second option is for high-end finish areas of access panels.

* + - 1. Standard Floors: Supply 610mm x 610mm (24" x 24") self framing metal access panels with integral locks as approved by Consultant, where required for access to concealed controls and equipment, by Le Hage Metal Ltd., or Acudor Products Limited, or approved equal.
      2. Specialty Floors: Supply 905mm x 905mm (36" x 36") seamless, glass fibre reinforced gypsum access panels, complete with drop in door. Frames complete with tapered edge for taping joints into adjacent gypsum ceiling and wall board. Basis of Design Materials: Pop-Out, Square Corner Access Panel by Castle Access Panels and Forms Inc.

1. execution
   1. EXAMINATION
      1. Examine gypsum wallboard panels for damage and existence of mould. Install only undamaged panels.
      2. Examine gypsum wallboard in accordance with GA-231 for water damage.
      3. Examine areas and substrates, with installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
      4. Proceed with installation only after unsatisfactory conditions have been corrected.
   2. preparation
      1. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
      2. Coordinate installation of gypsum board suspension systems with installation of acoustical ceiling tiles (ACT) suspension systems. Where gypsum board suspension systems abut ACT systems, ensure that ceiling tiles grid fit into gypsum grid without affecting overall design and appearance.
      3. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
   3. installation, general
      1. Conform to ASTM C 840, except as otherwise specified herein. Co-operate with mechanical, electrical, and other trades to accommodate fixtures, fittings, and other items in wallboard areas.
      2. Review extent of temporary heat provided. Carry out the work of this Section only when temperature is maintained and controlled in the range of 13 deg. C to 21 deg. C for at least 24-hours before installing gypsum wallboard and is maintained or can be maintained until joint compound and adhesives are dried or cured.
      3. Bring gypsum board into contact, but do not force into place.
   4. GYPSUM WALLBOARD - SINGLE LAYER APPLICATION
      1. Metal Studs:
         1. Apply gypsum wallboard with screws. Erect wallboard with long dimension at right angles to supports. For fire rated partitions, erect board vertically or horizontally according to the ULC listing. Locate end joints over supporting members.
         2. Locate vertical joints at least 305mm (12") from the jamb/head/sill lines of openings.
         3. For parallel application space screws at 200mm (8") O.C. at board edges at 305mm (12") O.C. on board fields.
      2. Fasteners:
         1. Perimeter screws shall be not less than 10mm (3/8") from edges and ends and shall be opposite the screws on adjacent boards.
         2. Screws shall be driven with a power screw gun and set with countersunk head slightly below the surface of the board.
      3. Joints: Finish all joints.
   5. GYPSUM WALLBOARD œ MULTI-LAYER APPLICATIONS
      1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
      2. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
      3. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.
      4. Joints: Finish joints in face layers only, unless otherwise required to achieve fire resistant ratings indicated, as hereinafter specified.
   6. TILE BACKING PANELS
      1. Install standard gypsum board panels in areas not subject to wetting to produce a flat surface.
      2. Install water resistant gypsum board in locations requiring tile applications in washrooms, and as indicated on the Drawings.
      3. Shim surfaces to produce a uniform plane across panel surfaces where tile backing panels abut other types of panels in the same plane.

SPEC NOTE: Delete the following if there is no fire-rated assemblies on the Project.

* 1. FIRE RESISTANT ASSEMBLIES
     1. Fire resistance rating of gypsum board assemblies and framing shall be as called for on Drawings or schedules, and as required to conform with applicable codes and requirements of authorities having jurisdiction.
     2. Appropriate ULC designs as listed in current ULC list of equipment and materials, Volume II, Building Construction, shall be placed when applicable. Extend partitions full height through ceiling space unless otherwise noted on Drawings.
     3. Vertical bulkheads in ceiling spaces over fire rated glazed partitions, doors and the like shall have same fire rating as the door or partition over which they occur. All such bulkheads shall be of drywall construction unless otherwise noted.
     4. Use fire rated gypsum board as specified.
     5. Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.
     6. Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide drywall enclosure or backing to maintain required fire rating, unless otherwise detailed.
  2. CONTROL JOINTS
     1. Install control joints using metal control joint strip as specified where:
        1. A partition, furring or column fireproofing abuts a structural element, dissimilar wall or partition assembly, or other vertical penetration, or ceiling.
        2. A ceiling or soffit abuts a structural element, dissimilar wall or partition assembly or other vertical penetrations.
        3. Wings of "L", "U" and "T"-shaped ceiling/soffit areas are joined.
        4. Construction changes within the plane of the partition or ceiling or soffit.
        5. Partition restrained ceiling or furring run exceeds 9144mm (30').
        6. Unrestrained ceiling dimensions exceed 15240mm (50') in either direction.
        7. Expansion or control joints occur in the base exterior wall.
        8. Wallboard is installed over masonry control joints.
        9. And elsewhere as indicated on the Drawings.
     2. Install in accordance with manufacturer's instructions. Where application is on furring members and double furring members at control joints, place one furring member on each side of the control joint.
  3. BULKHEADS
     1. Fur out bulkheads in areas indicated and as required to conceal mechanical, electrical, or other services in rooms where drywall finishes are scheduled, and elsewhere if called for on Drawings.
     2. Ensure hangers are installed as to prevent splaying.

SPEC NOTE: Delete the following if security mesh is not required on the Project.

* 1. SECURITY MESH
     1. Prior to installing gypsum wallboard, install security mesh to partition framing from floor to underside of structure with self-drilling, self-tapping flat head metal screws and washers at 12" o.c.at perimeter and field locations.
     2. Provide 1-1/2" end and side laps. Locate end laps over supporting members. Cut security mesh to suit partition framing.
     3. Accurately cut security mesh around duct openings and other penetrations. Provide additional framing as required to secure security mesh and maintain security barrier.
  2. ACCESS PANELS
     1. Access panels supplied by this Section and Divisions 20 and 26 shall be built-in by this Section where required in gypsum wallboard installations, in accordance with manufacturer's recommendations, to match and blend with surrounding surfaces. Refer to Drawings for locations.
  3. THERMAL BREAK
     1. Install self-sticking resilient sponge tape at edges of wallboard in contact with metal windows and exterior door frames to provide a thermal break. Adhere tape to casing bead and compress during installation.
  4. FINISHING
     1. Before proceeding with installation of finishing materials ensure the following:
        1. Wallboard is fastened and held close to framing and furring.
        2. Fastening heads in wallboard are slightingly below surface in dimple formed by driving tool.
     2. Levels of Gypsum Wallboard Finish:
        1. Level 0: Temporary construction only.
        2. Level 1: Plenum areas and above ceilings. Where a fire-resistance rating is required, finishing should be in accordance with reports of fire tests of assemblies that have met the requirements of the fire rating imposed.
        3. Level 2: Areas of water-resistant gypsum backing board under tile, exposed areas where appearance is not critical.
        4. Level 3: Service corridors and areas to receive heavy or medium textured coatings or heavy-duty wall coverings.
        5. Level 4: Areas to receive light textured coatings or lightweight wall coverings.
        6. Level 5: Areas to receive gloss, semi-gloss or flat sheen paints and critical lighting conditions. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat over entire surface for corridors, long hallways, walls, and ceilings longer than 7500 mm or walls higher than 3600 mm, and for all curved or angled wall surfaces.
     3. Finish gypsum wallboard in strict accordance with ASTM C 840, GA-214 and GA-216 and as follows:
        1. Fill and tape joints and internal corners and fill screw depressions in board face and smooth out along corner beads and metal strip with joint compound.
        2. Mix joint compound (powder) in accordance with manufacturer's written instructions.
        3. Prefill "V" grooves of rounded edges with special setting type joint compound using a 127mm to 150mm (5" to 6") joint finishing knife. Finish flush with tapered surface ready for tape reinforcing application. Allow prefill material to dry thoroughly before application of embedding compound and tape.
        4. Apply joint compound in thin uniform layer. Embed reinforcing tape accurately centred on joint and securely pressed in, leaving sufficient compound under tape to provide proper bond. Immediately apply skim coat over tape application. Allow to dry thoroughly before application of next coat.
        5. Apply fill coat finishing the tapered depression flush with board surfaces. Allow to dry thoroughly before application of finish coat.
        6. Apply finish coat extending slightly beyond the filler coat and feathered out onto the board surface. Do not apply finish coat to gypsum board scheduled to be sprayed with acoustic surfacing finish.
        7. Sand between coats and following the finishing coat, where necessary, and leave surface smooth and ready for painting. Finish screw depressions with filler material and finish coat as specified above.
        8. Joint and depression finish shall in no case protrude beyond the plane of the board surface.
        9. Furnish corner beads and metal trim flush with board surface using filler and finishing coats feathered out approximately 50mm (2") and 100mm (4") respectively onto the board surface.
        10. Provide metal casing beads at exposed edges, at junctions of gypsum/cement board with dissimilar material, at control joints and at junction with columns. Casing beads are required at perimeter of gypsum/cement wallboard ceilings and soffits. Fasten with screws at 305mm (12") O.C. along entire length.

SPEC NOTE: Modify the following finish level if level 5 finish is required instead of a level 4.

SPEC NOTE: Level 5 finish is extremely costly and will add time to the project schedule to achieve. Used in locations such as Lobby Entrance or spaces that require a "smooth" finish, like art displays.

* + - 1. Finish gypsum board to receive a Level 4 finish, unless indicated on the Drawings as a Level 5 finish.
  1. REPAIRS
     1. After taping and finishing has completed, and before decoration, repair all damaged and defective work, including non-decorated surfaces.
     2. Patch holes or openings 13mm (1/2") or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
     3. Repair holes or openings over 13mm (1/2"), or equivalent size, with 16mm (5/8") thick gypsum wallboard secured in such a manner as to provide solid substrate equivalent to undamaged surface.
     4. Tape and refinish scratched, abraded, or damaged finished surfaces including cracks and joints in non-decorated surface to provide smoke tight construction, fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.
  2. PROTECTION
     1. Protect installed products from damage during remainder of construction period.
     2. Remove and replace panels that are damaged.

end of section