
Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM B117-11, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - .2 ASTM C501-84(2009), Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
 - .3 ASTM C1026-13, Standard Test Method for Measuring the Resistance of Ceramic and Glass Tile to Freeze-Thaw Cycling.
 - .4 ASTM C1028-07, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
 - .5 ASTM D543-06, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
 - .6 ASTM D570-98(2010)e1, Standard Test Method for Water Absorption of Plastics.
 - .7 ASTM D638-10, Standard Test Method for Tensile Properties of Plastics.
 - .8 ASTM D695-10, Standard Test Method for Compressive Properties of Rigid Plastics.
 - .9 ASTM D790-10, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - .10 ASTM E84-13a, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .11 ASTM G151-10, Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources.
 - .12 ASTM G155-13, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's literature describing products, installation procedures and maintenance instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate all characteristics of the composite cast-in-place Tactile Warning Indicator, including material, profile, thicknesses, and installation methods.
- .3 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Submit two (2) Tactile Warning Surface samples, minimum 200 x 200, complete with fasteners. Samples shall be properly.
- .3 Submit to Departmental Representative material samples at least four weeks prior to commencing work.
- .4 Material Test Results:
 - .1 Submit current test reports from qualified, accredited independent testing laboratory in accordance with ASTM guidelines and indicating that materials proposed for use are in compliance with specification requirements and meet the properties indicated. All test reports submitted shall be representative.
- .5 Closeout Submittals:
 - .1 Provide manufacturer's operation and maintenance data for each type of Tactile Warning Indicator and accessories.

1.3 QUALITY ASSURANCE

- .1 Provide composite cast-in-place Tactile Warning Indicator as produced by a single manufacturer with a minimum of five years' experience in manufacturing Tactile Warning Indicator.
- .2 Installer's Qualifications: Engage an experienced installer certified in writing by the Tactile Warning Indicator manufacturer, who has successfully completed Tactile Warning Surface installations similar in material, design, and extent to that indicated for the Contract.
- .3 Cast-in-place Tactile Warning Indicators must be compliant with ADAAG, PROWAG, and CA Title 24 requirements. Division of the State Architect IR 11B-3 (1/26/05) and IR 11B-4 (1/01/11). IR 11B-4 (1/01/11) removed the requirement for a "staggered" pattern and now calls for the "square grid" (in-line) pattern.
- .4 Cast-in-place Tactile Warning Indicators shall meet or exceed the following test criteria using the most current test methods:
 - .1 Compressive Strength: 28,000 psi minimum, when tested in accordance with ASTM D695.
 - .2 Flexural Strength: 29,000 psi minimum, when tested in accordance with ASTM D790.
 - .3 Water Absorption: Not to exceed 0.10%, when tested in accordance with ASTM-D570.
 - .4 Slip Resistance: 1.00 minimum wet/dry static coefficient of friction when tested in accordance with ASTM C1028.
 - .5 Flame Spread: 25 maximum, when tested in accordance with ASTM E84.
 - .6 Salt and Spray Performance of Tactile Warning Indicator: No deterioration or other defects after 200 hours of exposure, when tested in accordance with ASTM B117.
 - .7 Chemical Stain Resistance: No reaction to 1% hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, and antifreeze, when tested in accordance with ASTM D543.

- .8 Abrasion Resistance: 500 minimum, when tested in accordance with ASTM C501.
- .9 Accelerated Weathering of Tactile Warning Indicator when tested by ASTM G155 or ASTM G151 shall exhibit the following result: $\Delta E < 5.0$ at 2,000 hours minimum exposure.
- .10 Tensile Strength: 11,000 psi minimum, when tested in accordance with ASTM D638.
- .11 Freeze/Thaw/Heat: No deterioration when tested in accordance with ASTM C1026.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Cast-in-place Tactile Warning Indicators shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy wrappings.
- .2 Store Tactile Warning Indicators in an area that is within an acceptable temperature range (4-32 degrees C). In particular, protect sealants from freezing.
- .3 Maintain storage facility in a clean dry condition to prevent contamination or damage to Tactile Warning Surfaces.

1.5 GUARANTEE

- .1 Tactile Warning Indicators shall be guaranteed in writing for a period of five (5) years from date of Contract's final completion. The guarantee includes manufacturing defects, breakage, and deformation.

Part 2 Products

2.1 MATERIALS

- .1 Composition: Tactile Warning Indicator shall be manufactured using a matte finish exterior grade homogeneous (uniform color throughout thickness of product) glass and carbon reinforced polyester based sheet molding compound (SMC) composite material. Truncated domes must contain fiberglass reinforcement within the truncated dome for superior structural integrity and impact resistance. A matte finish will be required on the Tactile Warning Indicator for superior slip resistance performance superior to that offered by a gloss finish.
- .2 Color: Color shall be homogeneous throughout Tactile Warning Indicator.
 - .1 Occupational Health and Safety – safety yellow.
- .3 Domes: Square grid pattern of raised truncated domes of 5 mm nominal height, base diameter of 23 mm and top diameter of 11 mm. Truncated dome spacing range of 40 mm-61 mm is acceptable. The preferred truncated dome spacing shall have a center-to-center (horizontally and vertically) spacing of 60 mm, measured between the most adjacent domes on square grid.
- .4 Configuration: The Warning Indicators shall feature a minimum of eight (8) embedded corrosion resistant 38 mm zinc inserts with 13 mm diameter bolts. Bolts must be covered with a structural water tight cap. Bolts must be located between the truncated domes (in

the field) for maximum protection of the Bolt integrity. Bolts are NOT to be located in the truncated dome.

- .1 The field area shall consist of a non-slip textured surface with a minimum static coefficient of friction of 0.80, wet and dry.
- .2 At a minimum, Warning Indicator thickness shall measure 6 mm nominal exclusive of the perimeter minimum 19 mm thick (nominal) by 25 mm wide flange structure. The body of the Tactile Warning Indicator must consist of a solid body for maximum strength and to eliminate the possibility of air entrapment and cracking. "Hollow back," "honeycomb," or "waffle tiles" are not acceptable for use on this Project.
- .5 Truncated Dome Surface of Warning Indicator shall be protected with factory installed plastic sheeting for cleanliness during the installation process. Installation guidelines shall be printed on the plastic sheeting in both English and French for customer convenience.
- .6 Dimensions:
 - .1 100mm wide x maximum practical length.
- .7 Cleaning materials used on site shall have low VOC solvent content and low flammability.
- .8 The Specifications of the concrete, sealants and related materials shall be in accordance with the Contract Documents and the guidelines set by their respective manufacturers.

Part 3 Execution

3.1 EQUIPMENT REQUIREMENTS

- .1 Provide all tools, equipment and services required for satisfactory installation per manufacturer's instruction.

3.2 PREPARATION

- .1 During all concrete pouring and Warning Indicators installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.
- .2 The physical characteristics of the concrete shall be consistent with the Contract Specifications while maintaining a slump range of 4 - 7 to permit solid placement of the Warning Indicator. An overly wet mix will cause the Warning Indicator to float. Under these conditions suitable weights such as 2 concrete blocks or sandbags (11 kg) shall be placed on each Warning Indicator.
- .3 The concrete shall be poured and finished, true and smooth to the required dimensions and slope prior to Warning Indicator placement.

3.3 INSTALLATION

- .1 Tactile Warning Indicator will not be allowed to be installed until all submittals have been reviewed and approved by the Departmental Representative.
- .2 Warning Indicators shall be installed as per manufacturer's written instructions.

- .3 To the maximum extent possible, the Warning Indicators shall be oriented such that the rows of in-line truncated domes are parallel with the direction of the ramp. When multiple Warning Indicators regardless of size are used, the truncated domes shall be aligned between the tactile warning surface tiles and throughout the entire Tactile Warning surface installation.
- .4 The Warning Indicators shall be tamped or vibrated into the fresh concrete to ensure that there are no voids or air pockets, and the field level of the Tactile Warning Indicator is flush to the adjacent concrete surface to permit proper water drainage and eliminate tripping hazards between adjacent finishes.
- .5 On Continuous Runs: leave a 3mm nominal gap between successive Tactile Warning Indicators. As part of the concrete finishing operation, apply 3 mm - 6 mm edge treatment around the perimeter of the Tactile Warning Indicators to facilitate future replacement of the Warning Indicator. A Urethane Sealant such as Sikaflex 1a, BASF NP1, or approved alternate shall be applied to the edge treatment for a watertight installation.

3.4 CLEANING AND PROTECTION

- .1 Protect Warning Indicators against damage during construction period to comply with manufacturer's written specifications.
- .2 During and after the Warning Indicator installation and the concrete curing stage, it is imperative that there are no walking, leaning or external forces placed on the Warning Indicators to rock the Warning Indicator, causing a void between the underside of the Warning Indicator and the concrete substrate.
- .3 Remove Protective Plastic Sheeting from Warning Indicator within 24 hours of installation. Particularly under hot weather conditions (27degrees C or higher), plastic sheeting will adhere strongly (resulting in difficult removal of same) to Tactile Warning Indicator when not removed quickly.
- .4 Clean Warning Indicators not more than four (4) days prior to date of substantial completion in each area of project. Clean Warning Indicators by method specified by Tactile Warning Indicators manufacturer.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A90/A90M-13, Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - .3 ASTM A121-[99], Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
 - .4 A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-138.1-96, Fabric for Chain Link Fence.
 - .2 CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence.
 - .3 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
 - .4 CAN/CGSB-138.4-96, Gates for Chain Link Fence.
 - .5 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .4 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .6 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .3 Shop Drawings to indicate: fence panel modules and types, materials, gauges, finishes, door and other openings, hardware, fastening methods to adjacent structure, and assembly methods .

1.3 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, and packaging material for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling in accordance with Waste Management Plan.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .7 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .8 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.
- .9 Unused paint or coating material must be disposed of at official hazardous material collections site as approved by Departmental Representative.
- .10 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .11 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Nominal coarse aggregate size: 40.
 - .2 Compressive strength: 32 MPa minimum at 56 days.
- .2 Chain-link fence fabric Type 1: to CAN/CGSB-138.1.
 - .1 Type 1, Class A, heavy style, Grade 1.
 - .2 Nominal wire diameter: 4.8 mm (6 gauge).
 - .3 Mesh size: 50 mm.
 - .4 Height of fabric: as indicated.

- .5 Fabric shall be continuous from top to bottom.
- .6 Breaking tensile strength: 10,000 N·min.
- .3 Chain-link fence fabric Type 2: to CAN/CGSB-138.1.
 - .1 Type 1, Class A, medium style, Grade 2.
 - .2 Nominal wire diameter: 3.5 mm (9 gauge).
 - .3 Mesh size: 50 mm.
 - .4 Height of fabric: as indicated.
 - .5 Fabric shall be continuous from top to bottom.
- .4 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe. Dimensions as indicated.
- .5 Tie wire fasteners: galvanized steel wire, 3.7 mm (9 gauge) diameter.
- .6 Tension bar: to ASTM A653/A653M, 5 x 20 mm minimum galvanized steel.
- .7 Gate frames: to ASTM A53/A53M, galvanized steel pipe, standard weight 45 mm outside diameter pipe for outside frame, 35 mm outside diameter pipe for interior bracing.
 - .1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized after welding.
 - .2 Fasten fence fabric to gate with twisted selvage at top.
 - .3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.
 - .4 Furnish double gates with chain hook to hold gates open and centre rest with drop bolt for closed position.
- .8 Fittings and hardware: to CAN/CGSB-138.2, galvanized steel.
 - .1 Tension bar bands: 5 x 20 mm minimum galvanized steel.
 - .2 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.
 - .3 Overhang tops to provide waterproof fit, to hold top rails and an outward projection to hold barbed wire overhang.
 - .4 Provide projection with clips or recesses to hold 3 strands of barbed wire spaced 125 mm apart.
 - .5 Projection of approximately 300 mm long to project from fence at 45 degrees above horizontal.
 - .6 Turnbuckles to be drop forged.
 - .7 Where nuts and bolts are required for fastening, nuts shall face compound exterior and be torqued tight.
- .9 Organic zinc rich coating: to CAN/CGSB-1.181.
- .10 Barbed wire: to ASTM A121, 2.75 mm diameter (12ga) galvanized steel wire or aluminum coated steel wire, 4 point barbs, 130 mm spacing. Refer to drawings for location of barbed wire extension on fence.

- .11 Manufacturer's nameplates on fence fabric and fence components are not permitted.

2.2 FINISHES

- .1 Galvanizing:
 - .1 For chain link fabric: to CAN/CGSB-138.1; average mass of zinc coating to be not less than 610 g/m² of uncoated wire..
 - .2 For pipe: 550 g/m² minimum to ASTM A90.
 - .3 For barbed wire: to ASTM A121, Class 2.
 - .4 For other fittings: to CAN/CSA-G164.
- .2 Aluminum coating:
 - .1 For barbed wire: to ASTM A121, Class 2.

Part 3 Execution

3.1 GRADING

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.
 - .1 Provide clearance between bottom of fence and ground surface of 5 mm to 10 mm.

3.2 ERECTION OF FENCE

- .1 Erect fence along lines as indicated and to CAN/CGSB-138.3.
- .2 Fence fabric shall be installed on the interior courtyard side of the fence posts.
- .3 Excavate post holes to dimensions indicated.
- .4 Space line posts maximum 2.5 m apart, measured parallel to ground surface.
- .5 Install corner post where change in alignment exceeds 10 degrees.
- .6 Install end posts at end of fence and at buildings.
 - .1 Install gate posts on both sides of gate openings.
- .7 Place concrete in post holes then embed posts into concrete to depths indicated.
 - .1 Extend concrete 50 mm above ground level and slope to drain away from posts.
 - .2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .8 Do not install fence fabric until concrete has cured minimum of 5 days.
- .9 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface or at inclination as indicated.
 - .1 Install braces on both sides of corner and straining posts in similar manner.

- .10 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.
- .11 Install bottom rail and fasten securely to end, corner, gate and straining posts.
- .12 Lay out fence fabric. Fence fabric shall be pulled taut before fixing in place. Stretch tightly to tension noted and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals.
 - .1 Pull test for Type 1:
 - .1 The application of a 12kg perpendicular pull at the midpoint of the mesh panel (midpoint of posts/rails) shall show a displacement of no more than 30 mm from the fence at rest plane
 - .2 Knuckled selvedge at bottom.
 - .3 Twisted selvedge at top.
- .13 Secure fabric to top rails, line posts and bottom rails with tie wires at 300 mm intervals.
 - .1 Give tie wires minimum two twists.

3.3 INSTALLATION OF GATES

- .1 Install gates in locations as indicated.
- .2 Level ground between gate posts and set gate bottom approximately 50 mm above ground surface.
- .3 Install gate stops where indicated.

3.4 TOUCH UP

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas.
 - .1 Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.5 CLEANING

- .1 Clean and trim areas disturbed by operations.
 - .1 Dispose of surplus material and replace damaged turf with sod as directed by Departmental Representative.

END OF SECTION

