

FLOOD MAP

SCALE: NOT TO SCALE

MAP NUMBER: 72000C3010J
EFFECTIVE DATE: NOVEMBER 18, 2009
FLOOD ZONE: X

DRD
DEPARTAMENTO DE RECREACIÓN Y DEPORTES

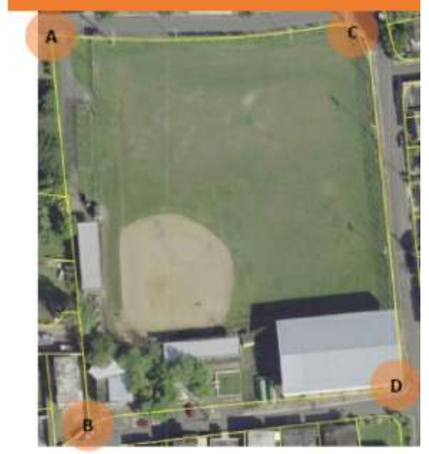
MAMEYAL BASEBALL PARK, DORADO

18°28'27.8"N 66°15'49.6"W

18.474375, -66.263780

- A — LAT. 18.474809, LONG. -66.264377
- B — LAT. 18.473662, LONG. -66.264254
- C — LAT 18.474825, LONG. -66.263460
- D — LAT. 18.473791, LONG. -66.263297

EXHIBIT A - FOUR CORNERS COORDINATES



DRD
DEPARTAMENTO DE RECREACIÓN Y DEPORTES

MAMEYAL BASEBALL PARK, DORADO

18°28'27.8"N 66°15'49.6"W

18.474375, -66.263780

No disturbed areas, waterways or wetlands.

EXHIBIT B – VICINITY MAP



LOCATION MAP

SCALE: NOT TO SCALE

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DEPARTAMENTO DE RECREACIÓN Y DEPORTES

MAMEYAL BASEBALL PARK, DORADO

18°28'27.8"N 66°15'49.6"W

18.474375, -66.263780

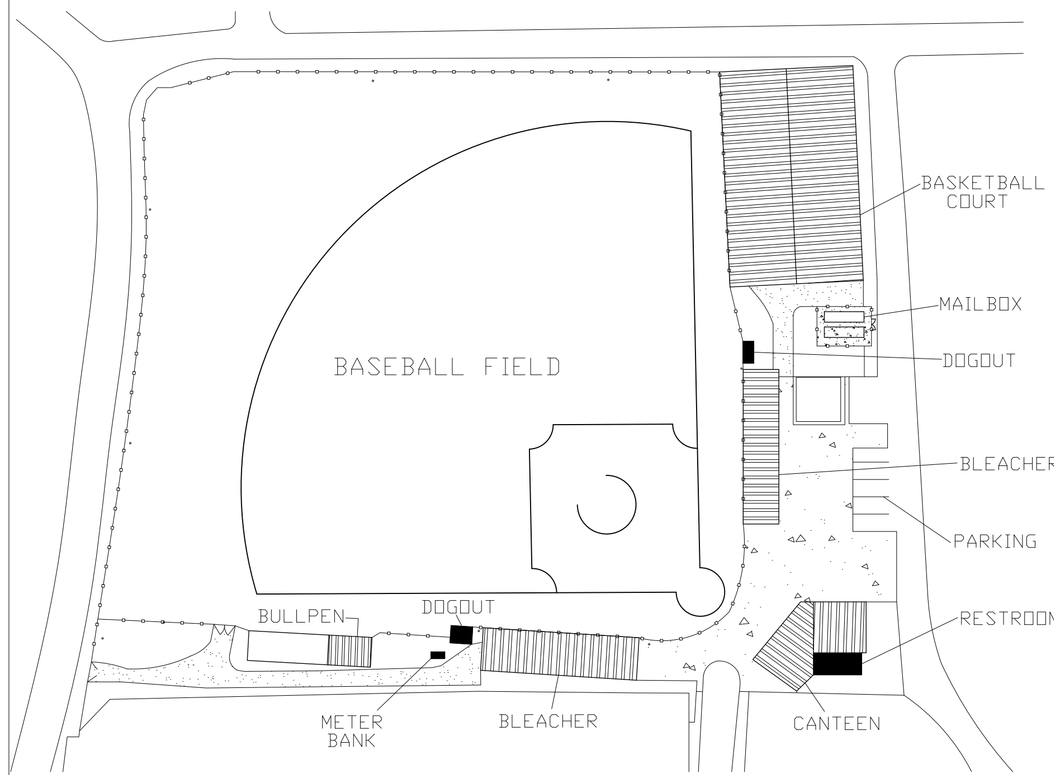
Existing footprint will remain.

EXHIBIT C – PROPOSED FOOTPRINT



MAMEYAL BASEBALL PARK FACILITY REPAIR, DORADO, PR

137 CALLE 11 BO MAMEYAL
DORADO, PUERTO RICO



SITE PLAN

NOT TO SCALE

FEMA PA CODE; (000-UFXSJ-00)
PROJECT NUMBER: 87524
PW NUMBER: 1863
DAMAGE INVENTORY NUMBER: 1259268
DR NUMBER: 4339

SHEET INDEX

SHEET	NAME	DESCRIPTION
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4	A-02	PROPOSED SITE PLAN AND FENCE
5	A-03	PROPOSED STRUCTURAL REPAIR DETAILS
6	A-04	PROPOSED PAINT WORK
7	A-05	SIGN DETAILS AND NOTES
8	S-01	PROPOSED DETAILS
9	S-02	PROPOSED CHAIN LINK GATE DETAIL
10	E-01	PROPOSED ELECTRICAL SITE
11	E-02	PROPOSED LIGHTINGS AND NOTES
12	E-02	PROPOSED LIGHTINGS FIXTURES

ON KEY LLC

[redacted]

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Project Name and Address:
Mameyal Baseball Park
Facility Damage Repair
137 Calle 11 Bo Mameyal
Dorado, Puerto Rico

Client Name and Address:
DEPARTAMENTO DE RECREACION Y DEPORTES DE PR
PO Box 9023207 San Juan
PR 00902-3207
Tel. (787) 721-2900 Fax (787) 268-1845
www.drd.pr.gov

Design by: B. QUINONES

No.	Revision/Issue	Plot Date:

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Fecha de Expiración: 2024-06-16
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ENG. BRENDALY QUIÑONES Lic. # 17715

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DEPARTAMENTO DE RECREACIÓN Y DEPORTES

PO Box 9023207
San Juan PR
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In this Page:

TITLE SHEET

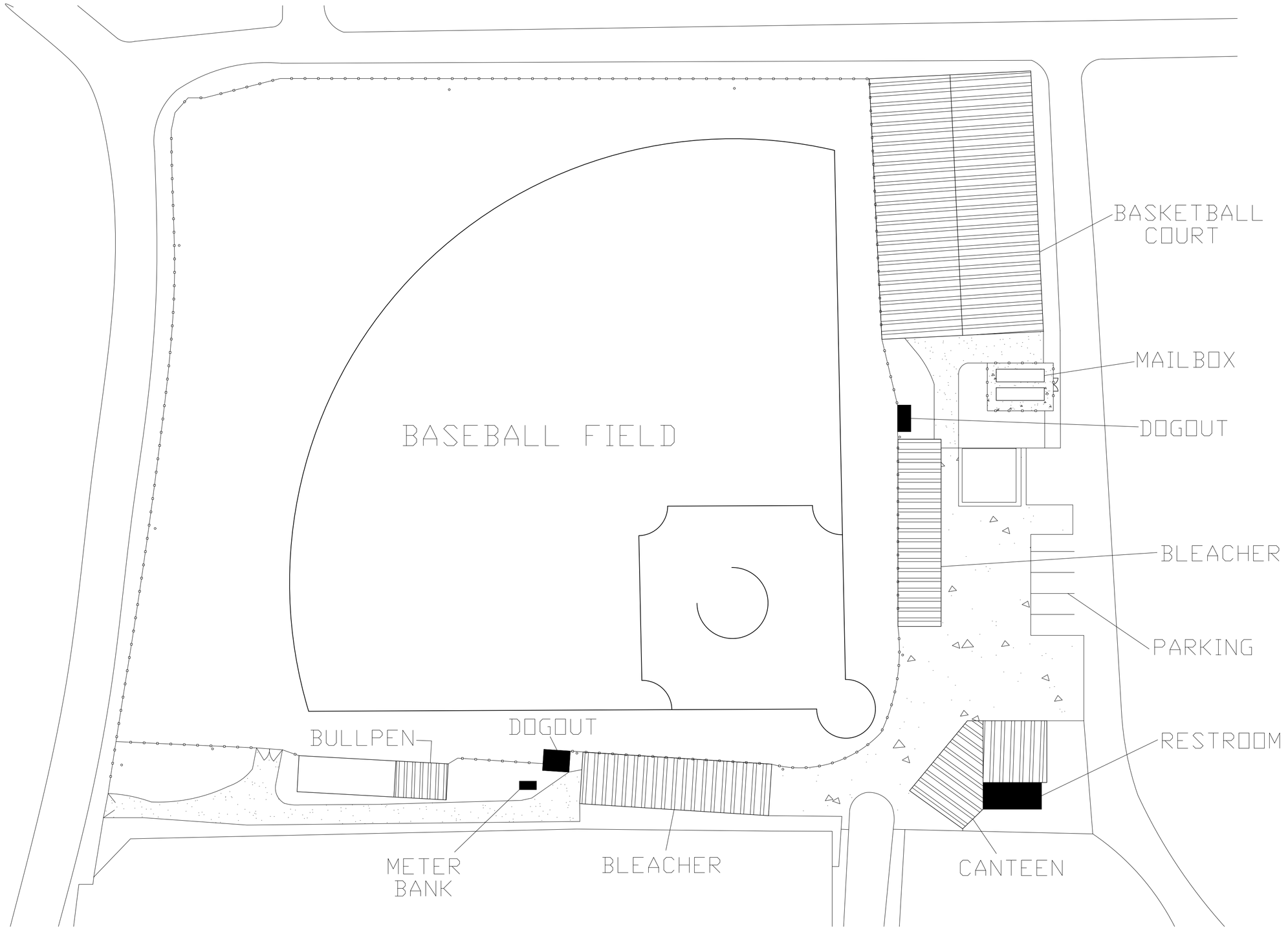
Scale:	Details scale:
1" = 3/32"	AS NOTED

Job #: 2023-000123	Sheet No.
Date: JULY 30 2023	T-01
Check by: SEPT 10 2024	



LOCATION PLAN

NOT TO SCALE



EXISTING AND DEMOLITION SITE PLAN

NOT TO SCALE

GENERAL NOTES

NOTES:

1- In activities that backfill is required the contractor must use A-2-4 or similar compacted in layers of 6" inches thickness at 95% and been verified by laboratory tests, which will be paid by the contractor.

2. All document included in this bidding process are part of the contract.

3. The contractor shall connect the structure to the existing water and sewer connection services of the site if it where not connected.

4. Demolition and construction disposal will be contractor's responsibility.

5. The contractor will be responsible to implement Plan CEST, PFE (Permiso de Fuente de Emision) and DS3 (Desperdicios Solidos no Peligrosos) as required by the Junta de Calidad Ambiental. (If required)

6. The contractor shall maintained the site clean and free of debris during work in progress.

7. A boundary shall be identified on field to isolated the construction area from the areas that are not impacted. The limit will be defined using a temporary fence that must be provided by the contractor.

8. The contractor will be responsible for all the demolition and debris disposal during the construction. Everything must be coordinated with the Consultant including any foundation demolition if it where the case.

9. "The contractor will plant Soisa Meyer grass in tight squares in all the Green areas affected by the construction.

10. All site dimensions must be verified on site by the contractor.

11. The contractor shall be responsible for any damage cause by the contractor or his employee to the existing infrastructure on the field.

12. All sidewalks finishes shall be broom finish.

13. The contractor shall be familiarized with the existing site conditions before the bidding.

14. The construction site perimeter will be protected with a temporary fence.

15. The contractor will submit a work plan in addition to the cost breakdown for payment for owner's Consultant approval.

16. If applicable any slopes that are generated on the site will not have a slope greater than 1:1 and shall be duly stabilized with Jute or a Similar approved geotextile product and Soysa Meyer grass will be tightly installed for permanent stabilization.

17. The contractor Will familiarize himself with the included Electrical and structural notes and specifications where applicable.

Buy American Act Requirements:

Buy American requirements apply to purchases of iron, steel, and other manufactured products permanently incorporated into infrastructure projects. To be considered as being produced in the U.S., goods must be manufactured in the U.S. and at least 50% of the cost of their components must come from the U.S.

Additional Notes:

1) The contractor is responsible to verify the existing electrical system conditions and shall repair any damage found and leave the project fully operational, properly grounded, coordinated with all the other trades and with all the required equipment, interconnections, fittings, and appurtenances necessary for the safe operation of his intended use.

2) All the electrical installation shall be done in a neat and workmanlike manner, according to the latest edition of the National Electrical Code (N.E.C.), the Puerto Rico Electric Power Authority (LUMA) latest standards and the Negociado de Telecomunicaciones de Puerto Rico latest practices.

3) The contractor shall visit the job site and become acquainted with the existing field conditions.

4) The contractor shall submit with the proposal, the proposed Synthetic Acrylic System specifications with the warranty terms and conditions. The system must be equal or similar to the specified and shall comply with a minimum of minimum five (5) year warranty, excluding damages by improper use and wear due to normal use.

5) The contractor is responsible to comply with all laws, regulations, codes, professional licenses required by Municipal, State, Federal and Local laws.

6) To all existing concrete surface (where occur) – All spalling concrete must be repaired. Chip the existing loose concrete and treat the exposed rebar. Clean with a steel brush and apply (equal or similar) Loctite Extend Rust Neutralizer, apply (equal or similar) Sika Armatec – 110 EpoCem and then patch and finish the affected area with Vinyl Concrete Patch. For all product, follow the manufacturer mixing and application recommendations.

7) All basketball court marking paint must be Multisport Court (Basketball and Volleyball) as specified. Where volleyball pole system is missing, the contractor must include the new volleyball net pole system as per specifications.

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Facility Damage Repair
137 Calle 11 Bo Maneyal
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Design by: B. QUINONES

No.	Revision/Issue	Plot Date:

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SIGNATURE AND SEAL
ENG. BRENDALY QUIÑONES Lic. # 17715

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PO Box 9023207
San Juan PR
00902-3207

In this Page:
PROPOSED SITE PLAN

Scale: NOT TO SCALE
Details scale: AS NOTED

Job #: 2023-000502
Date: JULY 30 2023
Check by: SEPT 10 2024
Sheet No.
SI-01

PROPOSED SCOPE OF WORK

(A) 24J-14703R1- Mameyal Baseball Park Facility Damages Repair

Chain Link Fence and Gates

1) Remove and dispose of existing damaged 5' high chain link fence sections from the third base dugout to the left field corner and along the north side of the property perimeter fence. Approximately 447 LF.
2) Supply and install new 6' high chain link fence sections from the third base dugout to the left field corner, 190 LF and 310 LF along the north side of the property perimeter fence over a retaining wall with swales. See Detail.
3) Supply and install a new double 6' high swing gate in the left field fence next to the bullpen to access the vehicle entrance. 16' wide. One (1) ea.
4) Remove and dispose of existing damaged 12' high chain link fence sections making up the bullpen in the third base area. Approximately 156 LF.
5) Supply and install new 12' high chain link fence making up the bullpen in the third base area. Approximately 156 LF.
6) Supply and install a new single 7' high swing gate for the bullpen in the northeastern corner facing north. 3' wide. One (1) ea.
7) Remove and dispose of existing damaged 16' high chain link fence sections from the third base dugout to the home base area, to the right field corner, and to the northeastern corner of the property fence. Approximately 700 LF.
8) Supply and install new 16' high chain link fence sections from the third base dugout to the home base area, to the right field corner, and to the northeastern corner of the property fence. Approximately 700 LF.
9) Supply and install a new single 7' high swing gate between the baseball field and the covered basketball court centralized to the court. 3' wide. One (1) ea.
10) Paint all the remaining chain link fences. Use metallic oil base. See paint notes.
11) Galvanized steel chain link #6 gauge 2" mesh.
12) Use three (3in) diameter poles for ten (10FT) and higher heights chain link fence. Use eight (8) FT max separation between poles.
13) Refer to standard drawings for chain link fence and gates details.
14) Supply and install a new fence topper all along the perimeter of the outfield, left field, and right field fences. Equal or similar to model 01160 Poly-Cap by Baseball Fence Toppers. Approximately 467 LF.
15) Demolish existing pedestrian entrance wall at the North side and construct new entrance with a now galvanized steel rotary gate with a concrete slap and ramp 18' x 7'. See drawings.





(B) *Facility Damage – Bleachers*

1) Repair concrete bleacher sections:
   a. Spalling concrete repair - Chip existing loose concrete and treat the exposed rebar. Clean exposed rebar with a steel brush and apply Loctite Extend Rust Neutralizer.
   b. Apply bonding primer and reinforcement corrosion protection.
   c. Clean, patch and finish the affected area with Vinyl Concrete Patch.
2) Paint existing bleachers and canopy structure. See paint notes.
3) Dimensions:
   a. First base bleachers 100' w x 79' l x 75" h. One (1) ea.
   b. Third base bleachers 8' w x 69' l x 8' h. One (1) ea.
4) Paint concrete bleachers. See paint notes.
5) Remove, supply, and repair by replacement of existing damaged downspouts for bleachers.
   a. First and third base bleachers 1180 LF.
6) Supply and install new 2" diameter steel handrails on the laterals, center and rear of the first base bleachers. Include footings. Meet the standard height. See details. 256 LF.
7) Remove supply and replace existing roof and siding galvanized metal panel 1,350 SF.
8) Remove supply and replace existing roof 2' siding metal panels, trims and flashings 420 LF Approx.
9) Install additional screws to existing roof panels, every 12" as per detail.



(C) *Facility Damage – Dugouts*

1) Spalling concrete repair - Chip existing loose concrete and treat the exposed rebar. Clean exposed rebar with a steel brush and apply Loctite Extend Rust Neutralizer.
2) Apply bonding primer and reinforcement corrosion protection.
3) Patch and finish the affected area with Vinyl Concrete Patch.
4) Thin set concrete resurfacing of existing dugout floors. Equal or similar to NewCrete concrete Resurfacer by Rapid Set. 164 SF.
5) Dimensions: 104' w x 12' l x 104" h.
6) Two (2) ea.
7) Supply and install chain link sections for dugout near first base.
   a) 73' l x 52" h. One (1) ea.
   b) 75' l x 52" h. One (1) ea.
8) Supply and install chain link sections for dugout near third base.
   a) 79' l x 52" h. One (1) ea.
   b) 81' l x 52" h. One (1) ea.
9) Supply and install a new single 31" wide x 7' high swing gate in the dugout near first base.
10) Supply and install a new single 33" wide x 7' high swing gate in the dugout near third base.
11) Construction of new dugout extension (2ea). Includes a concrete slab 104" w x 12' l, new dugout canopy and close with chain link fence around.
12) Supply and install new TWO (2) concrete benches. See specifications.

Demolish and create a door opening.



(D) *Facility Damage – Concrete Benches*

1) Spalling concrete repair - Chip existing loose concrete and treat the exposed rebar on existing damaged concrete benches. Clean exposed rebar with a steel brush and apply Loctite Extend Rust Neutralizer.
2) Apply bonding primer and reinforcement corrosion protection.
3) Patch and finish the affected area with Vinyl Concrete Patch.
4) Paint with exterior wall paint. See paint notes.
5) Dimensions:
   a. 68" w x 68" l x 30" h. 13 ea.
   b. 19" w x 27" l x 18" h. Three (3) ea.
6) Replace existing outdoor gym fixture. See drawing. Paint all remaining to match the new one.



(E) *Facility Damage – Concrete Canteen and Restrooms Structure*

1) Spalling concrete repair - Chip existing loose concrete and treat the exposed rebar. Clean exposed rebar with a steel brush and apply Loctite Extend Rust Neutralizer.
2) Apply bonding primer and reinforcement corrosion protection.
3) Patch and finish the affected area with Vinyl Concrete Patch.
4) Dimensions: 36' w x 50' l.
5) Pressure wash cleaning of existing concrete roof. Approximately 1,800 SF.
6) Installation of new waterproofing system. Equal or similar to Dansoe Modified Asphalt Membrane Esterdam RM-5. The contractor shall provide a 10 YR warranty. Installation of product must be as recommended by the manufacturer. Approximately 1,800 SF.
7) Repair existing metal roof, replace existing trim, fascing (210 LF), gutters (170 LF) and downspouts (160 LF). See details on drawings.
8) Paint all structures. See paint notes.



(F) *Facility Damage – Restroom Renovations*

1) Remove and dispose of all restroom equipment: toilets, lavatories, and accessories.
2) Repair existing concrete wall plaster finish with the application of new wall finish product as manufactured by Master (equal or similar), used to renovate walls and ceilings.
3) Supply and install new ADA complaint restroom equipment and accessories include all fittings, valve, p-trap, tail piece, etc.
4) Clean and paint existing flooring with anti-slip coating. Refer to the Paint scope section for details.
5) Remove, dispose, and replace toilet fixture. Include toilet seats, fittings, and valve. Ensure the fixture fits in the existing sanitary connection.
6) Material Description (where occur or required):
   a. Lavatory: Wall-mounted, Vitreous China, white, 20-½ in x 18-¼ in with 4 in center faucet holes, front overflow, D-shaped bowl. Two (2) lavatories are needed.
   b. Faucets: Conventional widespread, 0.5 GPM pressure compensating, vandal-resistant multi-laminar spray. Factory set for a maximum of 0.08 gallons per cycle. Four (4) faucets are needed.
   c. Toilet Paper Dispenser: Surface-mounted, multi-roll, stainless steel, satin finish, 6-1/16" W x 11" H x 5-15/16" D. Holds two rolls up to 5-¼" in diameter. Theft-resistant, heavy-duty spindles. Two (2) toilet paper dispensers are needed.
   d. Floor: Refer to paint scope section for details.
   e. Toilets: Single flush. Flush volume is 1.1 GPF to 1.6 GPF. Outfitted with a 2-1/8 in fully glazed trap way, elongated toilet seat, Water Sense. Dimensions 16.5 in. H. 14 in. W. 28.25 in. D. Two (2) toilets are needed.
7) Product Reference: (where occur or required):
   a. Lavatory: Equal or similar to American Standard, Lucerne Wall Hung Lavatory Model 0355.012.
   b. Faucets: Equal or similar to American Standard Metering Faucet Model:1340.827.
   c. Toilet Paper Dispenser: Equal or similar to Bobrick Model B-2888 Classic Series.
   d. Floor: Refer to paint scope section for details.
   e. Toilets: Similar or equal to American Standard model Cadet PRO 1.28gpf/4.8 Lpf. Two Piece, elongated toilet with seat cover.
8) Install new full aluminum door. See door schedule on drawings.

(G) *Facility Damage - Concrete Sidewalks and Concrete Surfaces*

1) Pressure wash cleaning of existing sidewalks in front of both bleachers. Approximately 592 SF.
2) Thin set concrete resurfacing of existing sidewalks in front of both bleachers. Equal or similar to NewCrete concrete Resurfacer by Rapid Set. Approximately 592 SF.
3) Sidewalk replacement 315 SF. See details.



(H) *Facility Damage – Electricity Meter Concrete Base-Rev.*

1) Demolish and dispose existing concrete motor base pedestal and Electrical room. Dimensions: 40' w x 68' l x 90" h. One (1) ea.
1)
2) Construction of new 4 ft x 7 ft, reinforced concrete and cmu electrical room. See details on ADD drawings.
3) Install new double steel door. See details and notes on ADD drawings.
4) Install new metal roof. See details and notes on ADD drawings.
5) Paint the entire structure. See paint notes.



(I) *Facility Damage - Covered Multisport Court Roof Structure*

1) Roof dimensions: 77' w x 127' l.
2) Remove, supply and repair by replacement of metal roof panels 39' in length. Eight (8) ea.
3) Install additional screws every 12" where occur. All roof panels.
4) Repair existing basketball court steel column base. See details. 14 ea.
5) Remove, supply and repair by replacement of gutters. 508 LF.
6) Remove, supply and repair by replacement of downspouts. 15 LF. 12 ea.
7) Paint all structure.
8) See paint notes.
9) Construction of new natural swale along the north side of the covered multisport court.
10) Supply and install new roof bird net to all canopies and multisport court. Approximately 15,360 SF.





(J) *Facility Damage - Covered Multisport Court*

1) Remove existing basketball court markings. See Multisport Court Technical Specifications.
   a. Apply a paint stripper.
   b. Scrape away the paint.
   c. Rinse the concrete with a pressure washer.
2) Supply and install new acrylic basketball goal boards. (2 ea.)
3) Supply and install new Volleyball Ground Sleeves Kits, equal to or similar to Jaypro PVB-755. (2ea.)
4) Paint multisport court markings, volleyball net poles, and goal poles. See Multisport Court Technical Specifications.
5) See paint in general specifications.
6) Color to be selected by owner.
7) See paint notes.
8) Dimensions: 63' w x 92' l.



(K) *Facility Damage – Covered Multisport Court Concrete Table and Benches*

1) Spalling concrete repair - Chip existing loose concrete and treat the exposed rebar on existing concrete table and benches. Clean exposed rebar with a steel brush and apply Loctite Extend Rust Neutralizer.
2) Apply bonding primer and reinforcement corrosion protection.
3) Patch and finish the affected area with Vinyl Concrete Patch.
4) Paint with exterior wall paint. See paint notes.
5) Concrete benches dimensions: 20' w x 10' l x 16" h. Two (2) ea.
6) Concrete scoring bench dimensions: 16" w x 78" l x 20" h. One (1) ea.
7) Concrete scoring table dimensions: 20' w x 78" l x 40" h. One (1) ea.



(L) *Facility Damage – Covered Multisport Court Bleachers*

1) Repair concrete bleacher sections:
   a. Spalling concrete repair - Chip existing loose concrete and treat the exposed rebar. Clean exposed rebar with a steel brush and apply Loctite Extend Rust Neutralizer.
   b. Apply bonding primer and reinforcement corrosion protection.
   c. Clean, patch and finish the affected area with Vinyl Concrete Patch.
2) Paint existing bleachers. See paint notes.
3) Dimensions: 98" w x 14' l x 64" h. Two (2) ea.
4) Supply and install new 2" diameter steel handrails on the laterals and rear of both of the bleachers. Include footings. Meet the standard height. See details. Approximately 96 LF.



(M) *Paint General Specifications*

1) Paint all existing structures. (Bleachers, benches, steel structures, concrete structures, buildings, restrooms, canteen, basketball court, etc., where occur).
2) Clean and patch all existing concrete surfaces. See paint notes.
3) Flooring: Apply anti-slip floor coating designed for heavy pedestrian traffic.
4) Product Description:
   a. Steel Structures: Equal or similar to Sherwin Williams Pro Industrial DTM Acrylic Primer/Finish. Apply one coat of primer and two (2) coats of paint.
   b. Exterior Wall Paint: Equal or similar to Sherwin-Williams Quick Dry Interior/Exterior Stain Blocking Primer. Apply one coat of primer. Apply two (2) coats of paint. A-100 exterior acrylic latex.
   c. Interior Wall Paint: Equal or similar to Sherwin-Williams Moisture Vapor Barrier Interior Latex primer/sealer. Apply one coat of primer and two (2) coats of paint. Promar 400 Zero VOC Interior Latex Primer.
   d. All exterior concrete structure or item must be painted with exterior paint.
   e. See paint notes.
5) Patch and finish the affected area with Vinyl Concrete Patch.
6) All structures (steel / concrete) must be painted (interior / exterior).





(N) *SOW ELECTRICAL WORK*

Facility Damage - Field

1) Repair by replacement of existing meter base concrete pedestal.
2) Supply and replace existing 120v/240V,200 Amp, 1ph Nema 3R, disconnect switch and meter base.
3) Install New Distribution Panel.
4) New 3#4 THWN underground electrical line. (2000 LF Approx.)



(O) *Facility Damage - Baseball Field*

Baseball Field Lighting System

1) As part of field lighting system, the contractor must consider the following:

A) The installation of a new meter base equal or similar to GE industrial solutions model TSM420CSCUP, 200 A, NEMA 3R enclosure, surface mounting.
B) The installation of a new distribution panel, equal or similar to model GE LOAD CENTER MODELTLM4020SCU, 200 A, NEMA 3R, 1PH, 30 spaces.
C) The installation of a new disconnect switch GE, 200 Amp AC, 1PH, 120/240 V, 3R, 3 poles, 2 wires, non-fused equal or similar to model TGN3324R.
D) The contractor must install a control panel equal or similar to MUSCO control link contactor cabinet system.
E) All electrical installation must be done as per code, and regulations, and the contractor must provide an electrical certification to the owner.
F) The contractor must consider two (2) poles of 70.0 FT, two (2) poles of 50 FT and Four (4) poles of 60 FT, 34 luminaries Equal or similar to Six (6) – model TLC-BT-575, (22) – model TLC-LED-1200 and six (6) – model TLC-LED-900, including eight (8) precast self-support concrete pole base. All athletic poles must be grounded. (8ea). Include
One (1) Control-Link™ Cabinet.
G) The contractor must consider a dedicated circuit breaker for each pole.
H) The contractor must install new 3-#4 THWN underground electrical wiring. Use 2in min. diameter PVC SCHD. 40 conduits. See details. (2,000 LF Approx.)
i) The contractor must consider a Geotech study with at least two (2) boring soil tests.
J) Install all panels in the new concrete electrical room. See details.
k) The contractor must consider for all lighting fixtures to be installed, the installation of new rough-in, wiring, and on/off switches. Canteen, bleachers and restrooms.
L) The contractor must consider 3-1/0 THWN main feeder in 3" diam. Schd. 80 conduits. (100 LF). See details.
M) The contractor must provide a Master Electrician Certification.
Q) This proposal must include the construction of a new electrical room. See details on ADD drawings provided. Demolish existing meter bank concrete base and Electrical Closet.

2) Supply and install new pole pads in the outfield baseball field poles. Four (4) ea.



(P) *Facility Damage – Athletic Pole*

1) Supply and install new athletic pole luminaires for the athletic pole in the left field facing the bullpen and vehicle area. Equal or similar to model HL-SP06-500W by LED Sports Light. Include rough-in, wiring, electrical connection, and on/off switch panel. Installation as recommended by the manufacturer: Two (2) ea.
   a. LED exterior luminaire.
   b. Color Temp of 5000k.
   c. Fixture Voltage: AC100 to 277V
   d. Lumens: 75,000 lm
   e. Fixture Rated Life: 100,000 hr. Five (5) year warranty.

(Q) *Facility Damage – Metal Poles*

1) Remove, supply and repair by replacement of metal poles in the property. Approx 10' high. Ten (10) ea.
2) Remove, supply and repair by replacement of exterior lighting fixtures for metal poles in the property. Ten (10) ea. Equal or similar to model GL16INC Area Light by Energy Light, Inc Luminaires. Include rough-in, wiring, electrical connection, and on/off switch panel. Installation as recommended by the manufacturer.
   a. LED exterior luminaire.
   b. Color Temp of 5000k.
   c. Fixture Voltage: 120 to 277V



(R) ADDITIONAL NOTES:

1) The contractor is responsible to verify the existing electrical system conditions and shall repair any damage found and leave the project fully operational, properly grounded, coordinated with all the other trades and with all the required equipment, interconnections, fittings, and appurtenances necessary for the safe operation of his intended use.
2) All the electrical installation shall be done in a neat and workmanlike manner, according to the latest edition of the National Electrical Code (N.E.C.), the Puerto Rico Electric Power Authority (LUMA) latest standards and the Negociado de Telecomunicaciones de Puerto Rico latest practices.
3) The contractor shall visit the job site and become acquainted with the existing field conditions.

4) The contractor is responsible to comply with all laws, regulations, codes, professional licenses required by Municipal, State, Federal and Local laws.

5) The word "Typical" or "Typ.", "Standard Drawing" or "Std. DWG" and "where occur", means whenever or wherever the mentioned or illustrated conditions happened, the notes, detail or scope will apply.

6)Quantities and dimensions provided are approximate. The contractor is responsible to take measures and determining the quantities to be considered in the proposal, except when a partial repair is requested, the quantity or dimension shown will be considered as fixed.

(S) *Facility Damage – Roof Structure*

1) Supply and install new interior luminaires. Ten (10) ea. Equal or similar to model ValueLED UFO 2A High Bay by Sylvania luminaires. Include rough-in, wiring, electrical connection, and on/off switch panel. Installation as recommended by the manufacturer.
   a. LED exterior luminaire.
   b. Color Temp of 5000k.
   c. Fixture Voltage: 120 to 277V
   d. Lumens: 34,560 lm
   e. Fixture Rated Life: 150,000 hr. Five (5) year warranty.
2) Supply and install new exterior lighting fixtures. Four (4) ea. Two (2) on the south side and one (1) on the east and west sides of the siding panel's exterior. Equal or similar to model ValueLED Area Light 3A by SYLVANIA Luminaires. Include rough-in, wiring, electrical connection, and on/off switch panel. Installation as recommended by the manufacturer.
   a. LED exterior luminaire.
   b. Color Temp of 5000k.
   c. Fixture Voltage: 120 to 277V
   d. Lumens: 20,000 lm
   e. Fixture Rated Life: 100,000 hr. Five (5) year warranty.
3) Remove, supply and repair by replacement of existing weatherproof receptacles, equal or similar to Duplex Convenience Receptacle. Three (3) ea
   a. 15A / 125V grounding type surface mounted GFI (Ground Fault Interrupter)
   b. Include weatherproof boxes and covers.



(T) *Facility Damage – Concrete Bleacher Canopies – Two (2) ea.*

1) Supply and install new florescent lighting fixture with new LED lighting fixtures. Equal or similar to model CNY LED Canopy Lighting by Lithonia Lighting. Include rough-in, wiring, electrical connection, and on/off switch panel. Include all switches and covers. Installation as recommended by the manufacturer: Six (6) ea in total
   a. LED Interior/Exterior Luminaire
   b. Color Temp of 4000k.
   c. Fixture Voltage: 120 to 277V
   d. LED replacement for: Up to 250W MH
   e. Lumens: 6,600 lm
   f. Fixture Rated Life: 50,000 hr. Five (5) year warranty.

(U) *Baseball Field - Field Work*

1) The contractor is responsible for the repair of the existing damaged infield.

2) Remove all grown sod inside the infield area and apply an industrial herbicide to prevent future grow.

3) Rake the area and remove all debris.

4) To repair the infield surface, use a mix equal to 55 percent sand, 30 percent clay, and 15 percent silt covering material.

5) Prepare the lawn area as recommended by the guida provided.

6) Follow the guide provided. (Where apply)

7) Install baseball bases set.

8) Supply and install new two (2) foul poles. Equal or similar to model Grand Slam Fencing Foul Pole Kit, Part # A15-941 by Anthem Sports.
   a. Two 6' high reinforced PVC foul poles wrapped in 8' high Safetoam.
   b. Includes two ground sockets and six 10' yellow tie wraps for attachment.
   c. Compatible with temporary, in-ground fencing (see illustration).
   d. Image for illustration purposes only.



4) Re-grade existing finished grade to create a natural swale for natural drainage. And install new catch basin. See details. (160 LF)

ON KEY LLC

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Project Name and Address:
Mameyal Baseball Park
Facility Damage Repair
137 Calle 11 Bo Mameyal
Dorado, Puerto Rico

Client Name and Address:
DEPARTAMENTO DE RECREACION Y DEPORTES DE PR
PO Box 9023207 San Juan
PR 00902-3207
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Design by: B. QUINONES

No.	Revision/Issue	Plot Date:

Brendaly Quiñones Villodas
Ingeniero
Licenciado
Lic. 17715-PE
Puerto Rico
Fecha de Expiración: 2024-09-10
HAND-COPY
SIGNATURE AND SEAL
ENG. BRENDALY QUIÑONES Lic. # 17715

DRD
DEPARTAMENTO DE RECREACIÓN Y DEPORTES

PO Box 9023207
San Juan PR
00902-3207

In this Page:

PROPOSED SCOPE OF WORK

Scale:	Details scale:
NOT TO SCALE	AS NOTED

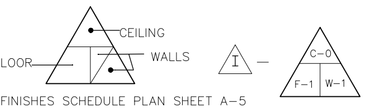
Job #: 2023-000502	Sheet No.
Date: JULY 30 2023	A-01
Check by: SEPT 10 2024	



LOCATION PLAN

NOT TO SCALE

FINISHES LEGEND:



NOTE: SEE FINISHES SCHEDULE PLAN SHEET A-5

FINISHES SCHEDULE

MKD	MATERIAL & MANUFACTURER	REMARKS
F-1	APPLY ANTI-SLIP FLOOR COATING DESIGNED FOR HEAVY PEDESTRIAN TRAFFIC EQUAL OR SIMILAR TO AMERICAN SAFETY TECHNOLOGIES AS-150 HAPS.	ONE COAT OF PRIMER AND TWO COAT OF PAINT . COLOR TO BE SELECTED BY THE ENGINEER.
W-1	LATEX PAINT COATING EQUAL OR SIMILAR TO SHERWIN WILLIAMS A-100. SEE PAINT SPECIFICATIONS.	ONE COAT OF PRIMER AND TWO COAT OF PAINT COLOR TO BE SELECTED BY THE ENGINEER.
C-0		

DOORS SCHEDULE

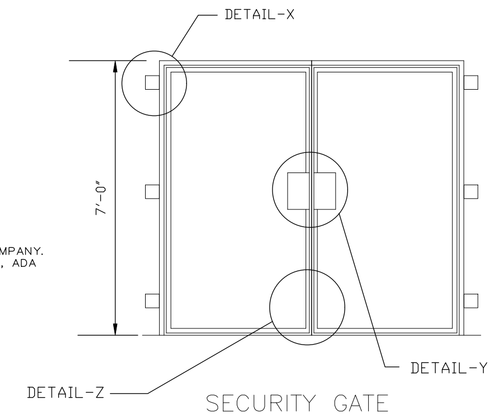
MKD.	WALL OPENING W	WALL OPENING H	THICK	HARDWARE SET NO.	REMARKS	FINISHED
1	3'-0"	80"	1 3/4"	1,2,3,4	NEW ALUMINUM DOOR HEAVY DUTY	WATERBASE ENAMEL PAINT ALUMINUM FRAME
2	5'-0"	84"	1"	-	DOUBLE STEEL DOOR	WATERBASE ENAMEL PAINT SEE PAINT NOTES

DOORS NOTES:

1. DOOR Mk'd 1 FOR CANTEEN AND RESTROOMS. (3 EA)
2. ALL HOLLOW METAL DOOR SHALL HAVE GALVANIZED STEEL FRAME GAGE 14. SEE FRAME DETAILS.
3. ALL DOOR HARDWARE SET MUST INCLUDE FULL MORTISE SPRING HINGE, STAINLESS STEEL, 4X4, SERIE 1250 HANGER COMPANY AND ONE FLOOR DOOR STOPPER DOME TYPE MODEL 241F HANGER COMPANY.
4. INSTALL NEW DOOR CLOSER EQUAL OR SIMILAR TO SERIES 600 BY TELL MANUFACTURING. COMMERCIAL, ADA COMPLIANT, ANSI CERTIFIED, UL LISTED.

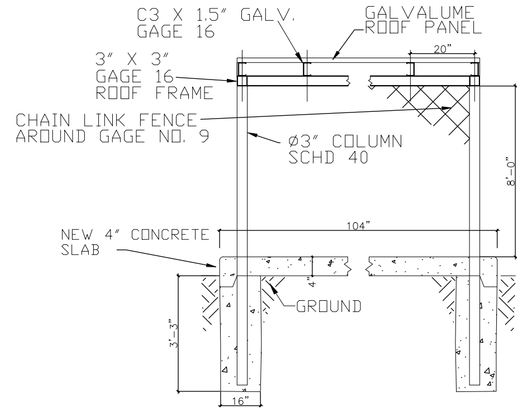
HARDWARE SETS:

1. EQUAL OR SIMILAR TO D91PD, SATIN CHROME FINISHED AS MANUFACTURED BY SCHLAGE D SERIES..
2. HARDWARE AS RECOMMENDED BY DOOR MANUFACTURED.
3. PROVIDE AUTOMATIC DOOR SWEEP AS MANUFACTURED BY SEAL-O-MATIC.



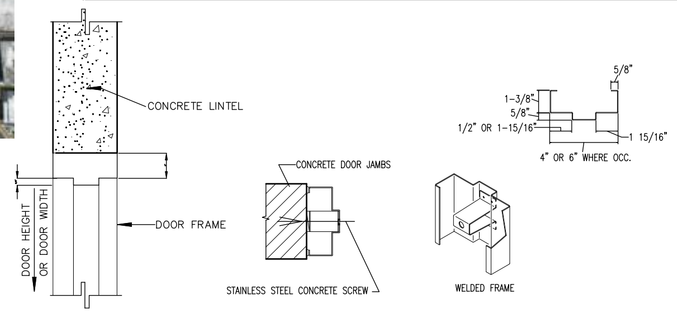
SECURITY GATE

(N.T.S.)



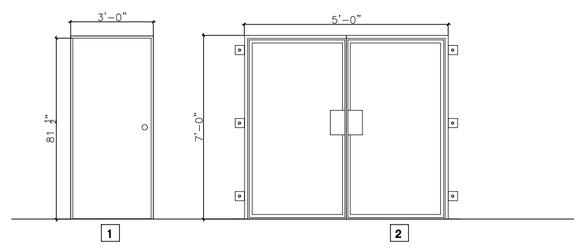
DUGOUTS EXTENSION CANOPY

(N.T.S.)



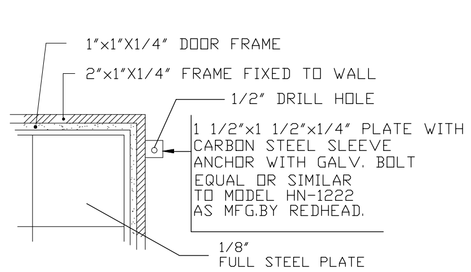
TYPICAL INSTALLATION DOORS DETAILS

(N.T.S.)



NEW PROPOSED DOOR

SCALE: NOT TO SCALE



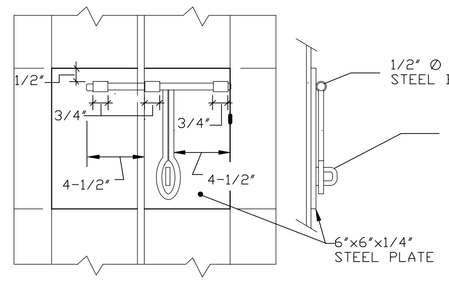
DETAIL-X

(N.T.S.)

NOTE: ALL SECURITY STEEL DOOR SHALL BE PAINTED WITH ONE COAT OF PRIMER AND TWO COAT OF FINISH PAINT. SEE PAINT SPECIFICATIONS.

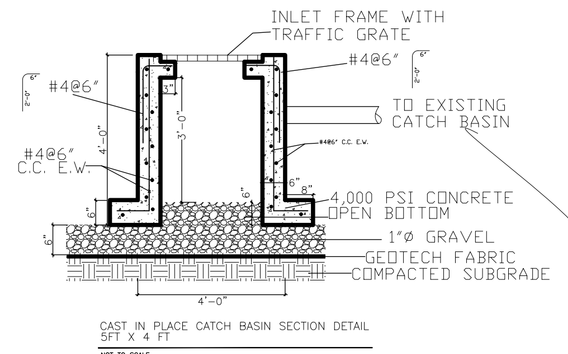
NEW PROPOSED STEEL DOOR DETAIL

SCALE: NOT TO SCALE



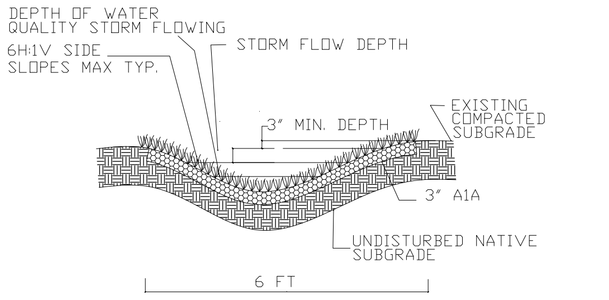
DETAIL-Y- LATCH LOCK

(N.T.S.)



CAST IN PLACE CATCH BASIN SECTION DETAIL 5FT X 4 FT

NOT TO SCALE



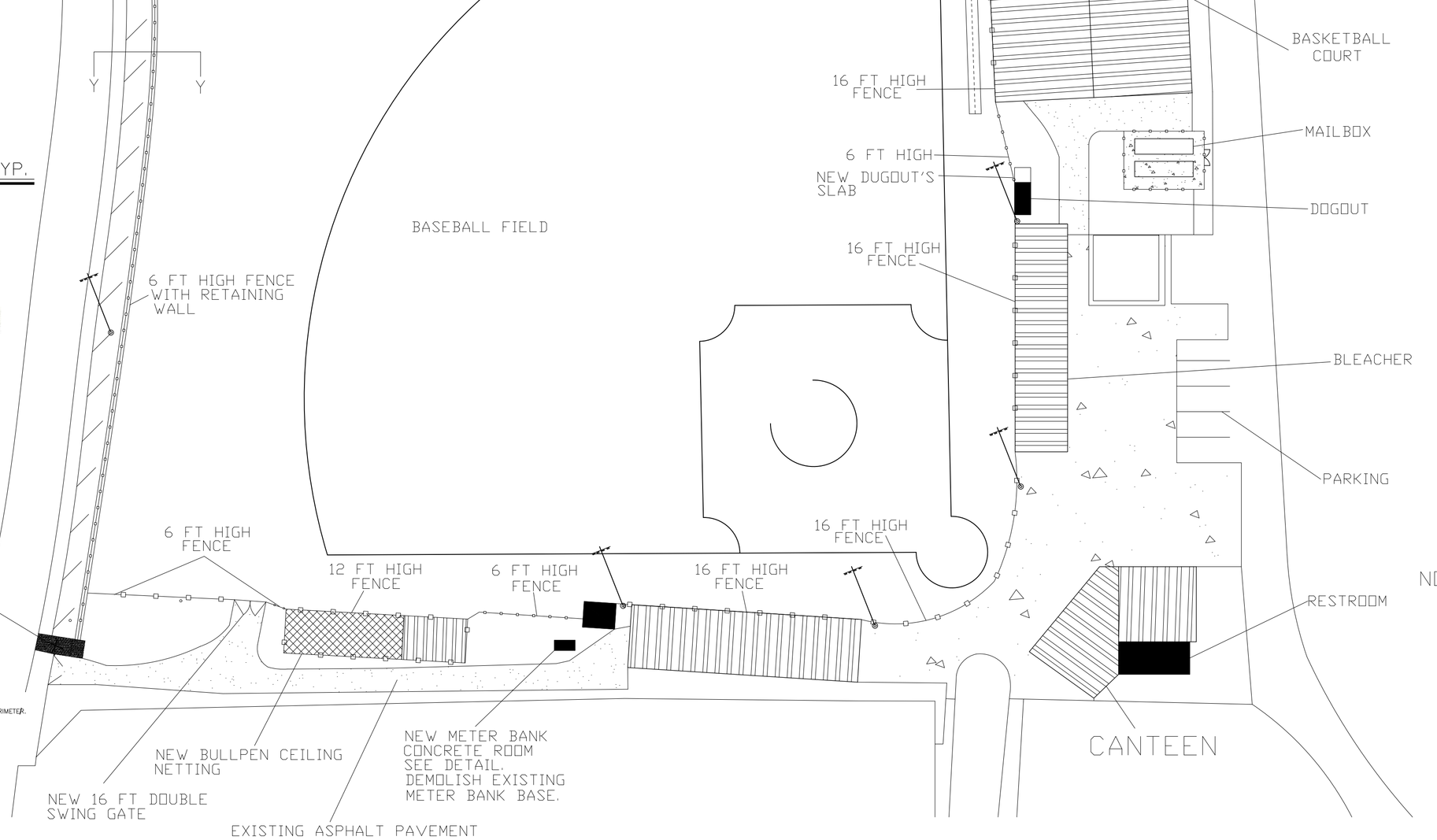
SECTION X-X - NATURAL SWALE DETAIL TYP.

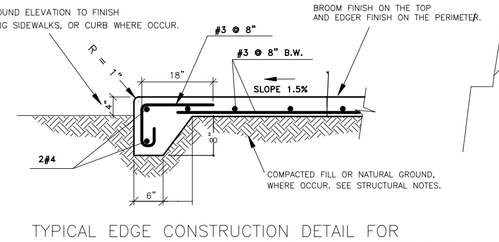
SCALE: NOT TO SCALE



Instalación portón Rotativo en Plataforma en hormigón con dos pallos fijos en alambre eslabonado, en tubo galvanizado Ga. 16 (8 FT - W) para entrada peatonal principal Parque Perfecto Serrano. Vea ilustración:

36" apertura de acceso min.



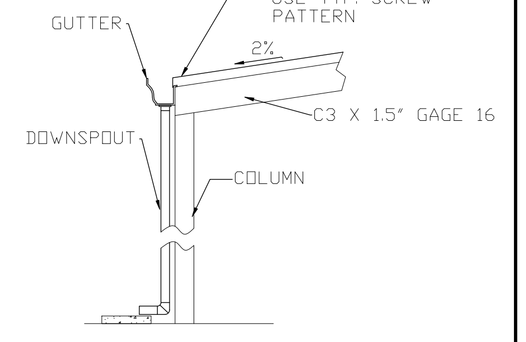


TYPICAL EDGE CONSTRUCTION DETAIL FOR ALL EXTERIOR SIDEWALKS AND SLABS, WHERE OCCUR

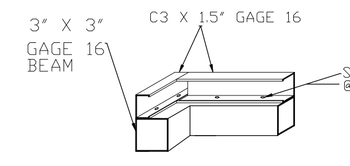
(N.T.S.)

PROPOSED CHAIN LINK FENCE AND SITE PLAN

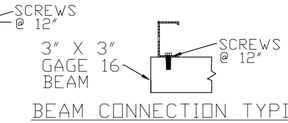
NOT TO SCALE



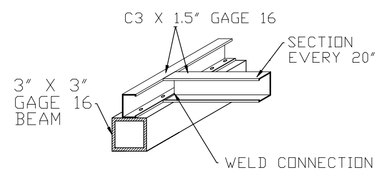
ROOF DRAINAGE DETAIL



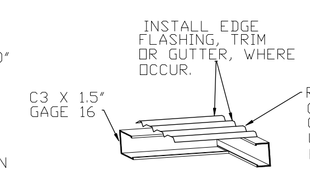
CORNER DETAIL TYP.



BEAM CONNECTION TYPICAL



INTERMEDIATE SECTION DETAIL TYP.



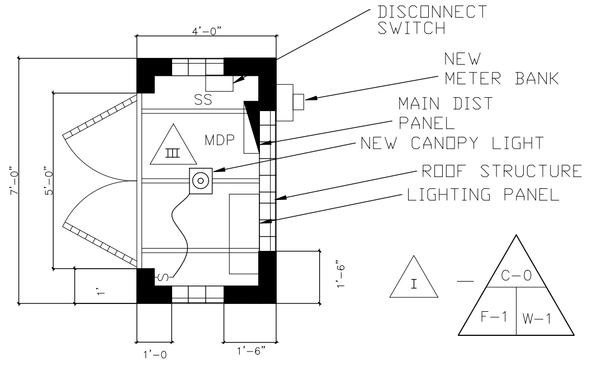
ROOF PANEL DETAIL

TYP. DUGOUT EXTENSION DETAILS

NOT TO SCALE

NOTES:

- USE CONCRETE SAW CUTTER FOR EXISTING SLAB SECCTION DEMOLITION.
- INSTALL ONE (1) DOUBLE STEEL DOOR 5 FT X 7 FT.
- SEE STRUCTURAL DETAILS.
- INSTALL NEW METAL ROOF. SEE DETAILS.
- PAINT ALL BUILDING SEE PAINT NOTES.
- INSTALL NEW CANOPY LIGHT SEE PAINT NOTES.



NEW ELECTRICAL ROOM LAYOUT

SCALE: NOT TO SCALE

ON KEY LLC

[redacted]

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Facility Damage Repair
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Dorado Puerto Rico

Client Name and Address:
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Design by: B. QUINONES

No.	Revision/Issue	Plot Date:

Brendaly Quiñones Villodas
Ingeniero
Licenciado
Lic. 17715 PE
Puerto Rico
Fecha de Expiración: 2024-08-19
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SIGNATURE AND SEAL
ENG. BRENDALY QUINONES Lic. # 17715

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PO Box 9023207
San Juan PR
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In this Page:

PROPOSED CHAIN LINK AND SITE PLAN

Scale: NOT TO SCALE

Details scale: AS NOTED

Job #: 2023-000502

Date: JULY 30 2023

Check by: SEPT 10 2024

Sheet No.

A-02

STRUCTURAL NOTES:

Except as otherwise noted. The following notes shall apply to all structural drawings:

1. Before and during construction the constructor shall check all related architectural, mechanical, electrical and equipment and all related drawings to coordinate dimensions, placing of sleeves, inserts, openings, anchorages, etc.

2. Detailing and construction (including mixing, placing, curing and formwork removal) shall comply with the requirements of the following publications, last revision.

a. For concrete structures

Manual Of Standard Practice for Detailing Concrete Structures (ACI-315).

Building Code Requirements for Reinforced Concrete (ACI-318)

Specifications for Structural Concrete for Buildings (ACI-301)

3. No other joint, opening, slot or groove than shown on plans shall be permitted without previous approval and provision by the designer, all construction joint surfaces shall be cleaned and roughened immediately before concreting and as instructed in the references in note 2.

4. No horizontal joints shall be allowed in slabs and beams. Any stop in concrete work shall be made at center of span with a vertical bulkhead.

5. Constructor shall provide camber for initial elastic deflection of slabs and beams.

6. Foundations shall be located at the depth and on the soil (or piles) of the natures and allowable supporting strength as specified in the soil report. Subsoil information, boring logs and recommendations shall be requested by the constructor from the Soil consultant.

7. Shoring of basement or other retaining walls shall not be removed until supporting slabs have been poured and attained sufficient strength.

8. Except for pile supported footings all soil bounded by planes drawn from the footing bottom perimeter with a slope of 1 vertical to 2 horizontal, shall be undisturbed soil.

9. Open cuts may be used as formwork for footing and retaining walls, in such case. Wall thickness shall be increased to provide a 3" clear concrete cover to reinforcement adjacent to open cut.

10. The following minimum concrete cover shall be provided for reinforcing bars, prestressing tendons or ducts.

Cast against and permanently exposed to earth	3"
Formed concrete exposed to earth or weather	
#9 through #18 bars	2-1/2"
#8 bars, 5/8 in. wire, and smaller	2"
Not exposed to weather or in contact with the ground slabs, walls, joists	
#14 and #18 bars	1-1/2"
#11 and smaller	1"
Beams girders columns	
Ties, stirrups or spirals	2"
deformed billet steel bars	A-615 Grade 60
welded wire mesh	A-185
steel wire	A-82
structural steel	A-36
steel pipe columns	A-501
structural tubing columns	A-500 Grade B

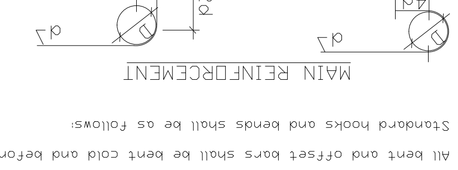
12. The splices of the minimum length of lap shall be not less than 36 bar diameters. Do not use lap splices at points of maximum stress.

Wire mesh reinforcement shall lap the spacing of cross wires plus 2".

13. All bent and offset bars shall be bent cold and before they are placed in the forms.

14. Standard hooks and bends shall be as follows:

MAIN REINFORCEMENT



STIRRUPS AND TIES

15. Unless otherwise shown on drawings all beam reinforcement shall terminate in standard hooks. All reinforcement in slabs and beams shall be extended beyond the center line of the end support a minimum length of 30 bar diameters and all positive reinforcement (bottom reinforcement) shall be extended a mimum length of 6" over the support.

17. Provide dowels in footing, equal in size and number to vertical reinforcement. Spliced above footing according to note 12 and extending into footing with a standard hook at footing bottom (6" min. horizontal leg).

18. All fill shall be compacted to f_x95 of modified proctor density (ASTM D-1557).

19. Non structural slabs shall rest on undisturbed soil or compacted fill and shall be a min. 4" thick and reinforced with 6" x 6" - 6/6 welded wire mesh.

. Contraction joints shall be spaced at a max. of 20'-0" in each direction.

20. All block walls shall be reinforced horizontally every course with masonry wall reinforcement as Dur-O-Wall or similar.

21. Block walls shall be anchored to the structure with horizontal and vertical dowels #3@16" extending 1'-0" at each side of joint (alternate details may be used if previously approved by the designer).

Lintels over block wall opening shall have the same wall thickness and be reinforced with 2#4 top and bottom, extending 1'-0" beyond edges.

22. All bolted connections shall use A-325 bolts.

23. All welds shall comply with the "Structural Welding Code (A.W.S. D1.1) E 70xx electrodes.

24. The contractor shall submit shop drawings for approval prior to construction.

25. All steel structural elements shall have two shop coats of red oxide. All field welds shall be retouched with two coats of red oxide.

All exposed surfaces of the steel structure shall be painted with one coat of epoxy marine paint similar to Ferrotahne.

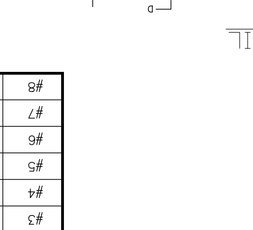
26. Concrete. All concrete shall develop the following compressive strength at 28 days.

	$f'c$	max w/c
footings & grade beams and slab on ground	3000 psi	0.65
cols & walls	3500 psi	0.60
roof slabs	3500 psi	0.60

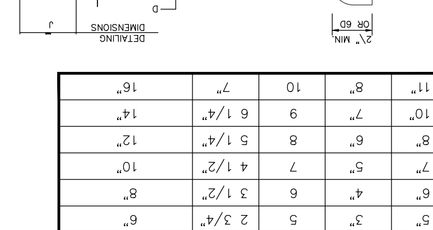
27. Maximum water soluble chloride ion (cl) in concrete, percent by weight of cement is 015.

TYP. ELECTRICAL ROOM ROOF DETAILS

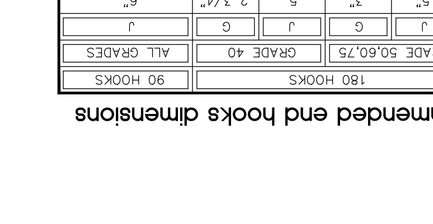
NOT TO SCALE

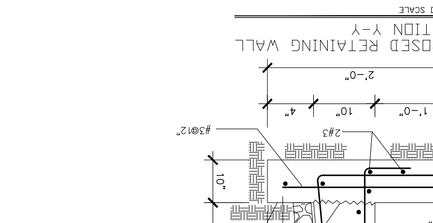


SIZES OF 90° HOOKS
(all grades)
NOT TO SCALE
D=6d FOR #3 TO #8
D=8d FOR #9 TO #18



SIZES OF 180° HOOKS
D=4d FOR #3 THROUGH #8
D=6d FOR #9 THROUGH #11
D=8d FOR #14 AND #18
NOT TO SCALE



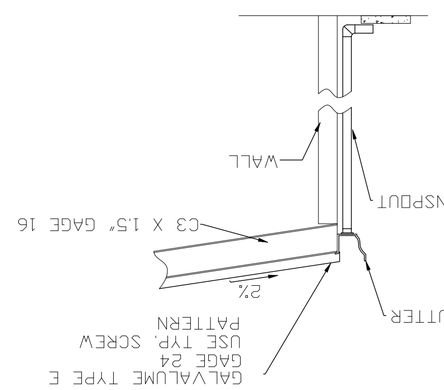


STIRRUPS HOOKS

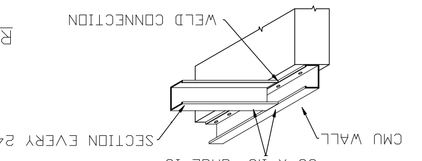
recommended end hooks dimensions

BAR SIZE	180 HOOKS			90 HOOKS	
	(GRADE 50,60,75)	(GRADE 40		ALL GRADES	
	J	G	J	G	J
#3	5"	3"	5	2 3/4"	6"
#4	6"	4"	6	3 1/2"	8"
#5	7"	5"	7	4 1/2"	10"
#6	8"	6"	8	5 1/4"	12"
#7	10"	7"	9	6 1/4"	14"
#8	11"	8"	10	7"	16"

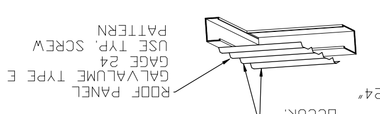
ROOF DRAINAGE DETAIL



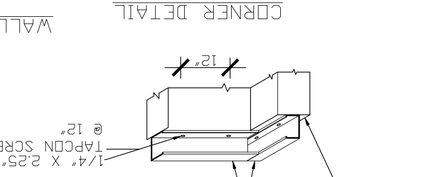
INTERMEDIATE SECTION DETAIL



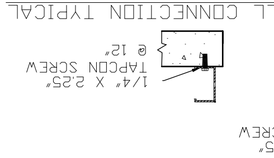
ROOF PANEL DETAIL



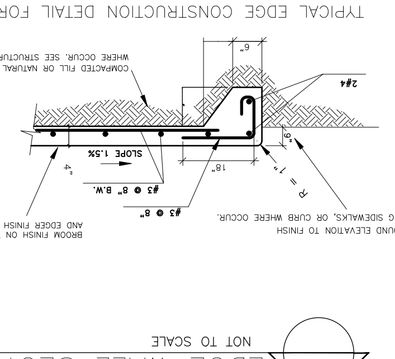
CORNER DETAIL



WALL CONNECTION TYPICAL

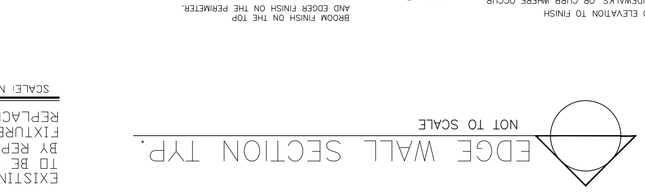


TYPICAL EDGE CONSTRUCTION DETAIL FOR
ALL EXTERIOR SIDEWALKS AND SLABS, WHERE OCCUR
(N.T.S.)



EDGE WALL SECTION TYP.

NOT TO SCALE

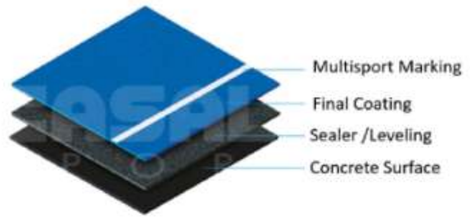

9" BEND
2'-0"
1'-0"
#3@12"
#4@6" E.W.
COMPACTED SOIL
#4@6" E.W.
MEMBRANE
.006 POLYETHELENE
MEMBRANE
.006 POLYETHELENE
NEW INTERIOR CONCRETE SLAB
NEW SIDEWALK
#3@12"
#4@10"
#4@10"
1'-8"
1'-8"
1'-8

Multisport Court Repair Scope of Work

Multisport Acrylic Synthetic Flooring System

Technical Specification

Basketball Court Surface Preparation



Acrylic Synthetic Sport Flooring System

EQUAL OR SIMILAR

EQUAL OR SIMILAR TO POLYSPORT SYSTEM BY OAFA

1) Concrete surface preparation

- Remove existing surface paint with paint removal product.
- Product should be compatible with acrylic system product.
- Scarify existing concrete.
- Pressure washes existing scarified concrete surface to remove all remaining dust.
- Treat all concrete cracks with product compatible and recommended by system's manufacturer.
- Seal existing concrete surface applying a synthetic resin-based filler using an acrylic resin based coating containing select sands, in water emulsion, especially formulated to seal concrete surfaces. Be sure that the product is compatible and recommended by system's manufacturer.

CHARACTERISTICS OF THE LIQUID PRODUCT			
Characteristic	U.M.	Value	Tolerance
Specific weight	Kg/dm³	1,64	± 0,1
Dry mass residue	%	75	± 3
Dry volume residue	%	59	± 3
Residue at 450°C	%	61	± 3
Brookfield viscosity (with Brookfield viscosimeter rotor no. 6, speed 10)	mPa·s	90000	± 5000
pH	-	8	± 1

- Surface must be sloped correctly to ensure rainwater runoff and prevent pooling.

2) Supply and apply Final Acrylic Coating System. Acrylic resin-based covering developed for multi-purpose sports flooring. The hard resin-based formula with UV ray resistant pigments and select sands that makes the ideal sports surfaces for many different games. Resin surfaces must be waterproof (non-draining).

CHARACTERISTICS OF THE LIQUID PRODUCT			
Characteristic	U.M.	Value	Tolerance
Specific weight	Kg/dm³	1,7	± 0,1
Dry mass residue	%	76	± 3
Dry volume residue	%	60	± 3
Residue at 450°C	%	65	± 3
Brookfield viscosity (with Brookfield viscosimeter rotor no. 6, speed 2)	mPa·s	210000	± 12000
pH	-	8	± 1

- Coverage as recommended by manufacturer.
- Ductile and resistant to abrasion
- Weather Resistant
- Maintenance Free
- Always available to play even when a heavy rain or hot weather have occurred.

3) Basketball court marking – use a highly covering acrylic paint, especially developed to mark field (2") lines on acrylic surfaces.

CHARACTERISTICS OF THE LIQUID PRODUCT			
Characteristic	U.M.	Value	Tolerance
Specific weight	Kg/dm³	1,38	± 0,1
Dry mass residue	%	54	± 0,5
Dry volume residue	%	36	± 0,5
Residue at 450°C	%	37	± 0,5
Brookfield viscosity (with Brookfield viscosimeter rotor no. 6, speed 5)	mPa·s	23000	± 2000
pH	-	9	± 1

- See typical color pattern
- See basketball court layout.

Buy American Act Requirements:

Buy American requirements apply to purchases of iron, steel, and other manufactured products permanently incorporated into infrastructure projects. To be considered as being produced in the U.S., goods must be manufactured in the U.S. and at least 50% of the cost of their components must come from the U.S.

PAINT NOTES:

1. ALL INTERIOR AND EXTERIOR WALLS SHALL BE PAINTED WITH THREE COATS OF PAINT. THE INTERIOR THREE COAT SYSTEM CONSISTS OF A SEALER PRIMER COAT AND TWO FINISH COATS WITH 100 % ACRYLIC LATEX PAINT, EGGSHELL FINISH. EXTERIOR THREE COAT SYSTEM CONSISTS OF A QUICK DRY STAIN BLOKER AND SEALER PRIMER AND TWO FINISH COAT OF 100% ACRYLIC PAINT. COLOR TO BE SELECTED BY THE ENGINEER. PATCH AND REPAIR WITH CONCRETE PLASTER ALL SURFACE IF NECESSARY, BEFORE PAINT.

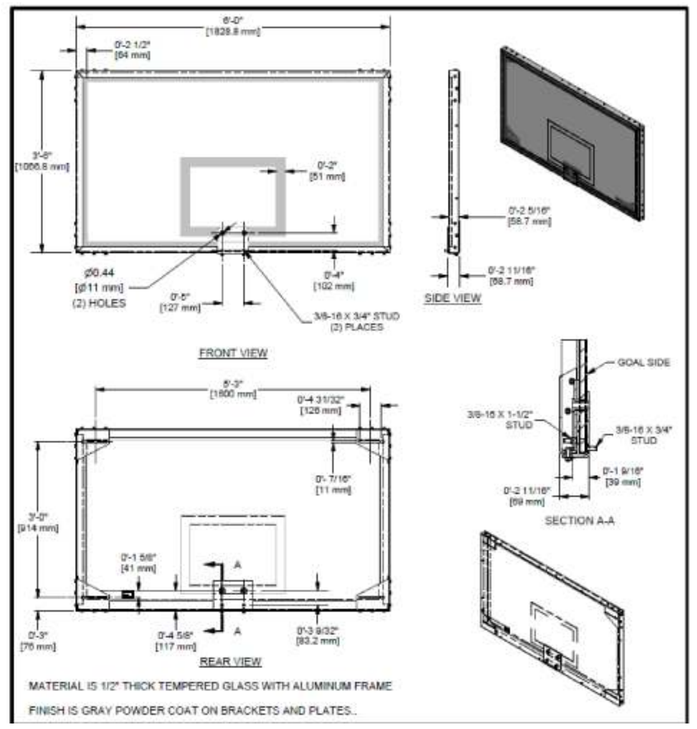
2. ITEMS NOT TO BE PAINTED WHICH ARE IN CONTACT WITH OR ADJACENT TO PAINTED SURFACES SHALL BE REMOVED OR PROTECTED PRIOR TO SURFACE PREPARATION AND PAINTING OPERATIONS. ITEMS REMOVED PRIOR TO PAINTING SHALL BE REPLACED WHEN PAINTING COMPLETED.

3. EXTERIOR WALL TO BE PAINTED SHALL BE CLEAN WITH WATER BLASTER MACHINE AND BE FREE OF FOREING MATTER BEFORE APPLICATION OF PAINT OR SURFACE TREATMENTS. OIL AND GREASE SHALL BE REMOVED PRIOR TO MECHANICAL CLEANING. CLEANING SHALL BE PROGRAMED SO THAT DUST AND OTHER CONTAMINANTS WILL NOT FALL ON WET, NEWLY PAINTED SURFACES.

4. BLISTERING, CRACKING, FLAKING AND PEELING OR OTHER DETERIORATED COATINGS SHALL BE REMOVED. SLICK SURFACES SHALL BE ROUGHENED. DAMAGED AREAS SUCH AS, BUT NOT LIMITED TO, NAIL HOLES, CRACKS, CHIPS, AND SPALLS SHALL BE REPAIRED WITH SUITABLE MATERIAL TO MATCH ADJACENTS UNDAMAGED AREAS.

5. STEEL STRUCTURE SHALL BE SANDED AND PAINTED WITH ONE ANTI –RUST PRIMER AND TWO COAT OF STOPS RUST INDUSTRIAL WATER BASE ENAMEL PAINT. BLISTERING, CRACKING, FLAKING AND PEELING OR OTHER DETERIORATED COATINGS SHALL BE REMOVED.

6. SEE PAINTING SPECIFICATIONS



MATERIAL IS 1/2" THICK TEMPERED GLASS WITH ALUMINUM FRAME

FINISH IS GRAY POWDER COAT ON BRACKETS AND PLATES..

PSS PERFORMANCE SPORTS SYSTEMS — EQUAL OR SIMILAR — GARED

MODEL AFRG42

ALUMINUM FRAME 72" X 42" RECTANGULAR GLASS BACKBOARD

The AFRG42 backboard shall be fabricated with an aluminum frame constructed of 0.200" thick extruded "F" channel with steel corner brackets. All steel components shall be powder coated with a durable gray finish. Aluminum-capped frame will not be acceptable. Manufacturer of backboard shall have over ten years of experience. Backboard shall meet NCAA and high school requirements.

Glass shall be ½" in thickness and fully tempered with white border and target lines permanently fused onto the surface. 12mm glass will not be considered equal to ½" glass, with a nominal thickness range of .485" to .515", and will not be used as a substitute for full ½" glass. Vinyl shock absorbing material insulates the glass from the frame. Goal mounting holes shall be on standard 5" horizontal and 4" vertical centers. Acrylic cushioning pad shall be used between steel mounting plate and glass to protect against possible breakage.

ACCESSORIES

GOALS

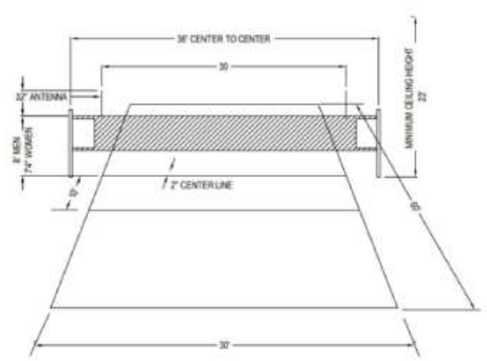
See Goal-Board Matrix specification sheet for goal compatibility.



* 2" lines marking
* Logo will be provided by owner.

NOTES:
1. ALL DIMENSIONS ARE TO THE OUTSIDE EDGE OF THE LINES.
2. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
3. DO NOT SCALE DRAWING.

DETAILED DRAWINGS
BASKETBALL



* 2" lines marking

NOTES:
1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
2. DO NOT SCALE DRAWING.

DETAILED DRAWINGS
VOLLEYBALL COURT DETAIL



* 2" lines marking
* Logo will be provided by owner.

Color Pattern

PAINT BASKETBALL COURT MARKING

SCALE: NOT TO SCALE

NOT FOR CONSTRUCTION

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No.	Revision/Issue	Plot Date:

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DRD-CONDICIONES ESPECIALES SUPLEMENTARIAS

I. DISPOSICIONES RELACIONADAS AL DESARROLLO DEL PROYECTO (según aplique):

a. El Contratista deberá familiarizarse con las condiciones existentes y con todas las particularidades que presenta la estructura a la cual se intervendrá

b. El Contratista será responsable de verificar la ubicación exacta y la condición de todos los componentes del proyecto, así como de los componentes del sistema eléctrico y del sistema de distribución de agua potable que existen en las áreas directamente afectadas por los trabajos correspondientes a este contrato.

c. De surgir alguna discrepancia entre los equipos, accesorios o dispositivos existentes a permanecer y los propuestos, el Contratista será responsable de discutir y aclarar la misma con el inspector y/o representante del dueño, antes de tomar cualquier decisión. El Contratista NO realizará trabajo alguno que considere adicional al contrato sin la autorización previa, por escrito, del inspector o representante designado de la DRD para este proyecto. Estos no serán remunerados

d. Las medidas o especificaciones establecidas como *estándar* en reglamentos y códigos, según el uso y aplicación, deberán predominar siempre sobre lo instalado en sitio o lo indicado en los Documentos de Contrato, a menos que se especifique lo contrario en los mismos. De especificarse lo contrario, el Contratista deberá confirmar dicha información con el inspector y/o representante designado de la DRD.

e. De surgir alguna discrepancia en relación con algún tipo de material, equipo o trabajo especificado, el Contratista deberá considerar que siempre prevalecerán los requisitos más restrictivos, incluyendo mayor cantidad, mayor calidad, mayor nivel de seguridad y el material, equipo o trabajo más exigente, según indicado en los Documentos de Contrato.

f. Todo cambio que surja durante la ejecución de los trabajos incluidos en contrato, ya sea por recomendación del Contratista o mediante una solicitud formal del DRD (a través de su representante designado y/o a través del inspector del proyecto), deberá informarse por escrito mediante carta firmada por el Contratista, con la recomendación y la aprobación de la DRD. De haber algún costo adicional o crédito por dichos trabajos, el mismo deberá mencionarse en dicha carta.

g. Cualquier duda o desacuerdo que tenga el Contratista deberá ser informado al DRD mediante correspondencia escrita, con copia a su representante designado y al inspector del proyecto.

h. El Contratista será responsable de realizar las reparaciones a las superficies y/o instalaciones físicas existentes que hayan sufrido daño por causa de los trabajos o actividades relacionadas al desarrollo de la obra, según sea requerido por el representante designado del DRD. Cualquier ruptura de tuberías, infraestructura mecánica o utilidades eléctricas, causada por los trabajos incluidos en este contrato, deberá ser reparada inmediatamente, de forma tal que los servicios afectados por dicha condición sean restablecidos a la mayor brevedad.

i. El Contratista deberá tomar todas las medidas necesarias para evitar:

j. La propagación de polvo fugitivo procedente de actividades de remoción o demolición selectiva y de acarreo de materiales o escombros, en estricto cumplimiento con las disposiciones establecidas en el Reglamento para el Control de Contaminación Atmosférica de la Junta de Calidad Ambiental (JCA) y la reglamentación federal aplicable.

k. La utilización de materiales y equipo que emitan gases y/o residuos tóxicos al ambiente, en estricto cumplimiento con las disposiciones establecidas en el Reglamento para el Control de Contaminación Atmosférica de la Junta de Calidad Ambiental (JCA) y la reglamentación federal aplicable.

l. La propagación de ruidos procedentes de las áreas impactadas por los trabajos incluidos en contrato que excedan los niveles máximos de ruido permitidos por ley, de acuerdo con las disposiciones establecidas en el Reglamento para el Control de Contaminación por Ruidos de la Junta de Calidad Ambiental (JCA) y la reglamentación federal aplicable.

m. La realización de cualquier actividad que pueda afectar adversamente la salud de los residentes de las comunidades aledañas al mismo, en cumplimiento con todas las leyes y reglamentos ambientales, estatales y federales, que sean aplicables. Es de notar que cualquier multa de OSHA notificada al DRD o al Representante Autorizado, como consecuencia, motivada, o relacionada con la conducta del Contratista por trabajos relacionados a este proyecto, será de la entera responsabilidad del mismo.

n. El Contratista deberá proveer el recipiente, camión o medio de almacenamiento y transporte adecuado para disponer, de forma inmediata (en un periodo de 24 horas del lugar designado en el sitio del proyecto para acumular o almacenar los mismos), de toda la basura o escombros que se generen como consecuencia de los trabajos incluidos en contrato. NO se permitirá la utilización de los recipientes de basura existentes en las instalaciones. Toda basura deberá disponerse con su contenido, de forma tal que, de ser tóxica o contaminante, se cumpla con todas las leyes y reglamentos ambientales (estatales y federales) aplicables a estas actividades. Recae como responsabilidad del Contratista el identificar el contenido del material y disponer del mismo adecuadamente, presentando como evidencia el manifiesto de disposición en original.

ñ. La disposición adecuada de todas las unidades, accesorios y equipos mecánicos/eléctricos a ser removidos como parte de este contrato, deberá realizarse siguiendo las indicaciones del inspector o representante designado del DRD para el proyecto de referencia y en cumplimiento con lo dispuesto en las especificaciones técnicas relacionadas y en todas las leyes y reglamentos ambientales (estatales y federales) aplicables para estas actividades, para lo cual se deberá presentar el correspondiente comprobante de disposición de desperdicios (en original) durante el proceso de desarrollo de estos trabajos.

a. El Contratista deberá implantar todas las medidas de seguridad que estime necesarias para delimitar y rotular las áreas impactadas por los trabajos relacionados a este proyecto, así como las áreas dispuestas para almacenaje de materiales y equipos, de forma tal que se pueda restringir el acceso a las mismas de maestros, estudiantes, empleados u otras personas ajenas a los trabajos incluidos en contrato, durante el desarrollo de la obra.

b. El Contratista deberá coordinar, con el funcionario designado como representante del DRD (inspector o coordinador del proyecto) y con el encargado (a) del lugar, el horario más adecuado para realizar los siguientes trabajos:

1. Acarreo y disposición de escombros generados por las actividades de demolición selectiva o remoción de unidades y equipos.

2. Se recuerda que el Contratista será responsable de mantener todas las áreas de trabajo limpias, durante y después de cada día laborable, y será responsable de llevar a cabo todos los trabajos incluidos en contrato, en estrecha coordinación con el representante designado para este proyecto (inspector o supervisor del proyecto), de forma tal que las obras no interrumpan o interfieran con las labores de los otros locales y las actividades que se llevan a cabo en estas instalaciones. De ser necesario realizar cualquier trabajo incluido en contrato, fuera de horas laborables, en días feriados o en fines de semana, el mismo deberá estar coordinado y autorizado (por escrito) por los funcionarios antes mencionados.

q. El Departamento de Recreación y Deportes (DRD) NO le requerirá al Contratista la instalación de una oficina de inspección (*Inspection Office*) para el proyecto de referencia.

II. DISPOSICIONES TÉCNICAS:

a. El Contratista proveerá e instalará toda la conexión razonable a los equipos eléctricos y mecánicos que se incluyan como parte de este contrato, aunque dicha conexión no esté ilustrada en planos. De haber una omisión o discrepancia en las especificaciones o planos, el Contratista será responsable de proveer e instalar el sistema mínimo requerido para que el equipo quede en servicio y la facilidad pueda operar funcionalmente, sin costo adicional al DRD y sin que se afecte la garantía de los equipos antes mencionados. La solución que provea el Contratista cumplirá con todos los códigos y reglamentos aplicables y será aprobada por el DRD.

Ejemplo de Rótulo de Proyecto

Rótulo tamaño 192"x96"







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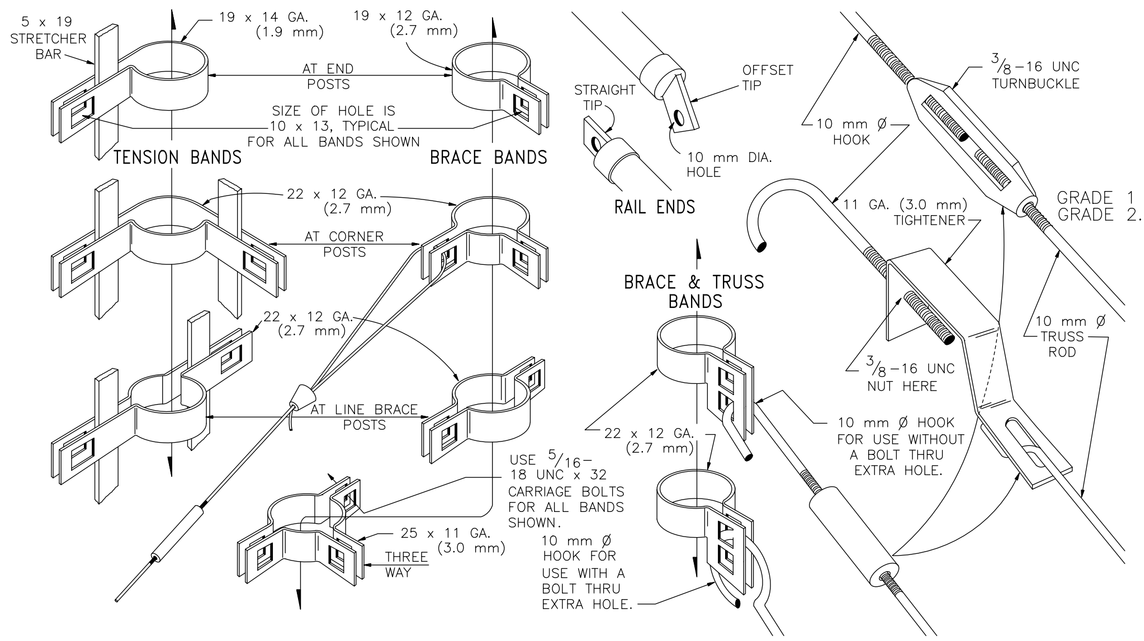


BANDS, RAIL ENDS & TIGHTENERS (DIMENSIONS SHOWN ARE MINIMUMS)

GENERAL NOTES

"H" (HEIGHT OF FABRIC) SHALL 3.048 M.

CHAIN LINK FENCE SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M 181.

CHAIN LINK FABRIC SHALL BE 50 mm MESH NO. 9 GAGE (3.76mm) GALVANIZED OR ALUMINUM COATED WIRE SECURELY FASTENED TO TENSION WIRE, LINE POSTS, RAILS, BRACES AND STRETCHER BARS SPACED AS SHOWN HEREON. WIRE FASTENERS AND TIE CLIPS SHALL BE NO. 11 GAGE (W&M) (3.05 mm) GALVANIZED STEEL WIRE OR NO. 7 GAGE (B&S) (3.66 mm) ALUMINUM WIRE, AND HOG RINGS SHALL BE NO. 9 GAGE (3.76 mm), ALL IN CONFORMANCE WITH ASTM F 626.

STEEL POSTS, RAILS AND GATE FRAMES SHALL CONFORM TO AASHTO M 181 TYPE 1,

AT THE CONTRACTOR'S OPTION, PIPE USED FOR FENCE CONSTRUCTION SHALL CONFORM TO THE DIMENSIONS AND WEIGHTS FOR EITHER "ORDINARY PIPE" OR " ALTERNATIVE PIPE" . "ALTERNATIVE PIPE" SHALL BE HIGH STRENGTH STEEL PIPE MEETING THE REQUIREMENTS OF FED. SPEC. RR-F-191/3C.

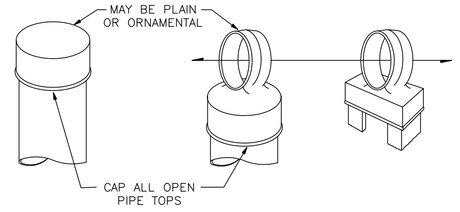
TENSION WIRE SHALL BE CONTINUOUS BETWEEN END OR CORNER POST AND LINE BRACE POST. A TURNBUCKLE OR OTHER APPROVED TIGHTENING DEVICE SHALL BE USED FOR EACH CONTINUOUS SPAN OF TENSION WIRE.

TENSION WIRE SHALL BE AS SPECIFIED IN AASHTO M 181.

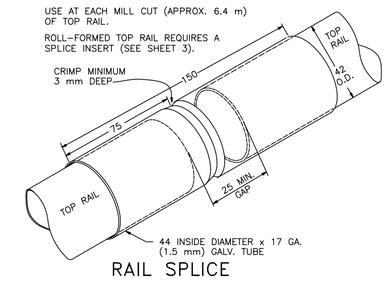
CONCRETE FOOTINGS SHALL HAVE TOPS CROWNED AT GROUND LEVEL AND SHALL BE CLASS A. CONCRETE WITH LIGHTWEIGHT AGGREGATE CONFORMING TO AASHTO M 195, WILL BE PERMITTED.

CHAIN LINK FABRIC UP TO 1520 mm HIGH SHALL BE KNUCKLED AT THE TOP AND BOTTOM SELVAGES. FABRIC OVER 1520 mm HIGH SHALL BE TWISTED AND BARBED ON THE TOP SELVAGE AND KNUCKLED ON THE BOTTOM SELVAGE.

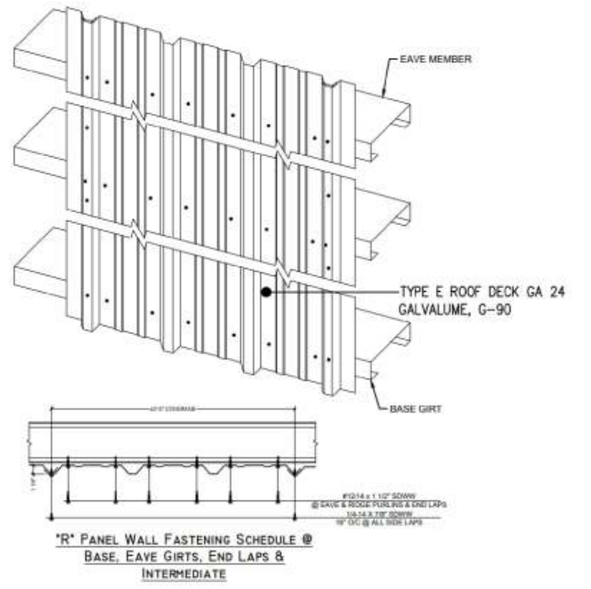
NOTE:
ALL FOOTING CONCRETE MUST BE 3,000 PSI
ALL STEEL PIPE MUST BE MT 40.



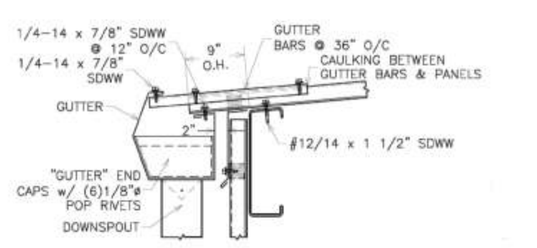
POST TOPS



RAIL SPLICE

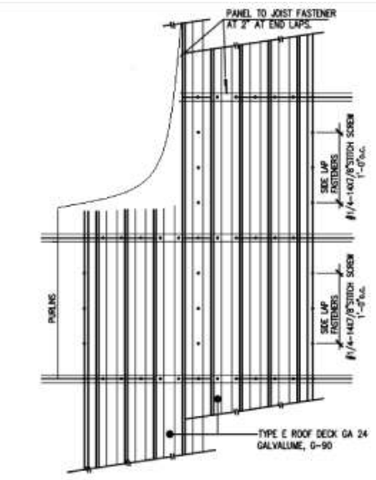


"R" PANEL WALL FASTENING SCHEDULE @ BASE, EAVE GIRTS, END LAPS & INTERMEDIATE



METAL GUTTER & DOWNSPOUT DETAIL

NOTES:
1. GUTTER TO BE CAULKED & LAPPED 4" MIN. AND POP RIVETED TOGETHER USING (8) 1/8"ø POP RIVETS.
2. FIELD LOCATE AND MARK DOWNSPOUT LOCATION IN BOTTOM OF GUTTER. DRAW LINE FROM CORNER TO CORNER AND CUT ALONG LINE. BEND TABS DOWN AND POP RIVET INSIDE DOWNSPOUT.
3. USE THE CHART TO THE LEFT FOR DIMENSION VALUES FOR YOUR PARTICULAR ROOF PITCH.
4. GUTTER SIZE AND GUTTER BAR SPACING MUST BE ADJUSTED TO SUIT LOCAL WEATHER PECULIARITIES AND/OR TO ACCOMMODATE LONG ROOF SLOPES.

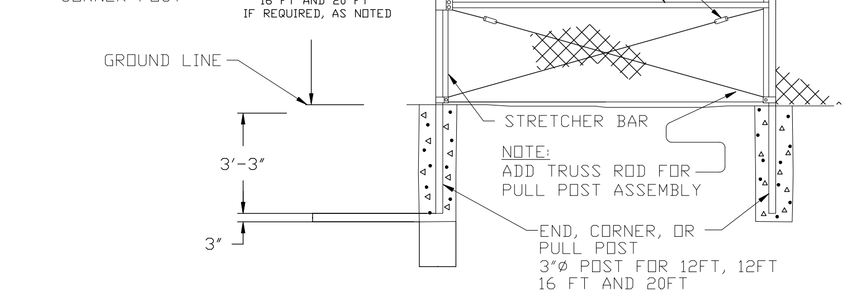


INSTALLATION INSTRUCTIONS

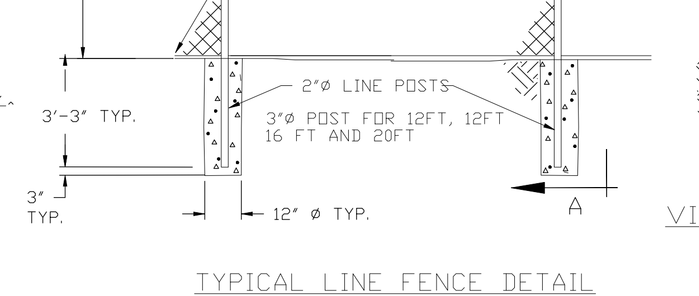
1- STEEL DECK PLATES SHALL SPAN AT LEAST 3 JOIST.
2- DECK SHEETS SHOULD BE PLACED IN ACCORDANCE WITH APPROVED ERECTION LAYOUT DRAWINGS SUPPLIED BY THE DECK MANUFACTURE'S STANDARS AND SHALL BE ERECTED BEGINING AT THE LOW SIDE TO INSURE THAT END LAPS ARE SHINGLE FASHION.
3- END LAPS SHALL BE 2" MINIMUM AND SHOULD OCCURS OVER SUPPORT.
4- ALL LAPS SHALL BE CENTER DIRECTLY OVER PURLINS
5- ALL FASTENERS SHALL BE IN ACCORDANCE WITH MANUFACTURE'S SPECIFICATION AND ERECTION LAYOUTS.
6- SUPPORT FASTENERS #12-14X1 1/4 SELF DRILLER
7- METAL DECK SHALL BE FACTORY MUTUAL APPROVED.

NOTES :
DECK SHALL BE FASTENED TO JOIST SO AS TO RESIST AN UPLIFT PRESSURE OF 80PSF.

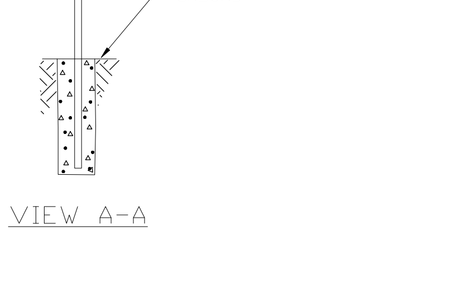
INSTALLATION DETAIL OF STEEL ROOF DECK (NOT TO SCALE)



CORNER OR END PANEL ASS'Y
PULL POST ASS'Y SIMILAR(EXCEPT AS INDICATED)
SCALE: NOT TO SCALE



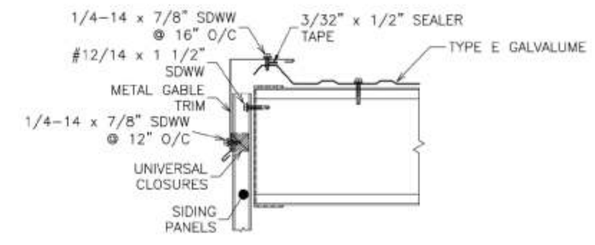
TYPICAL LINE FENCE DETAIL
SCALE: NOT TO SCALE



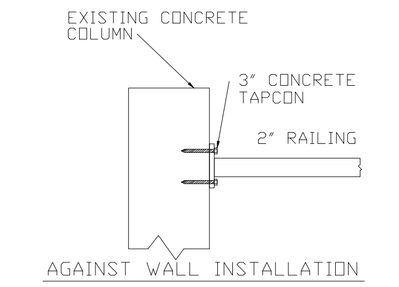
VIEW A-A

CHAIN LINK FENCE TYPICAL DETAILS

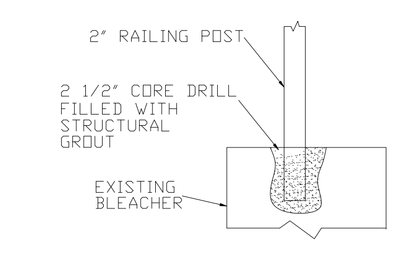
SCALE: NOT TO SCALE



METAL ROOF END CLOSURE TRIM DETAIL

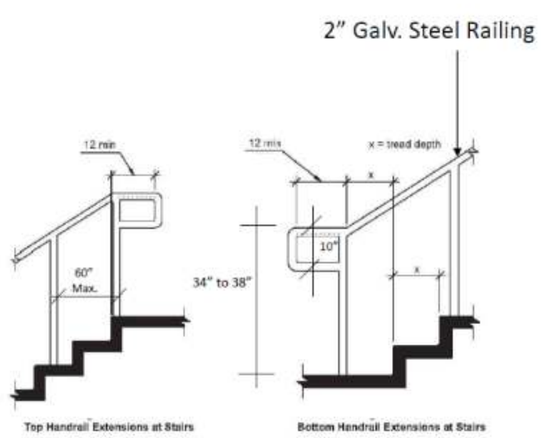


AGAINST WALL INSTALLATION

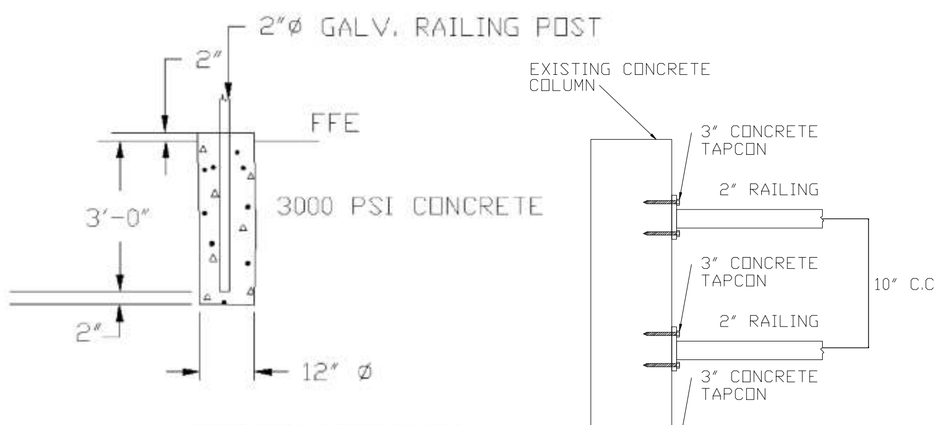


EXISTING STRUCTURE INSTALLATION

Railing Detail

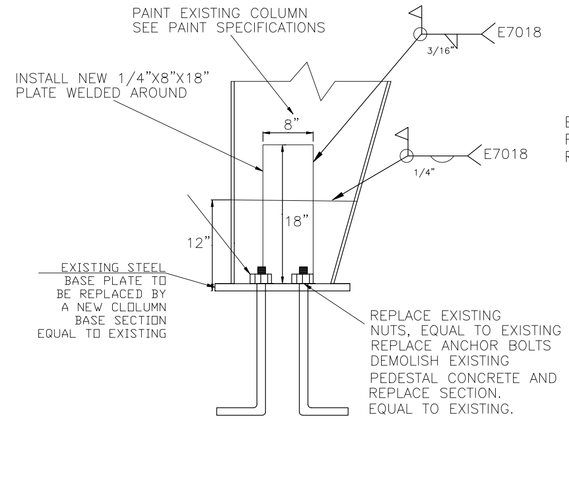


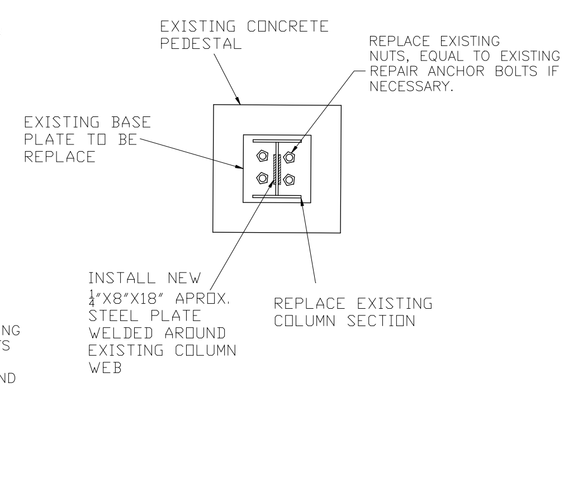
INSTALL NEW HANDRAILS
SCALE: NOT TO SCALE



RAILING CCONCRETE BASE

AGAINST WALL INSTALLATION





EXISTING COLUMN REPAIR

SCALE: NOT TO SCALE

Project Name and Address:
Mameyal Baseball Park
Facility Damage Repair
137 Calle 11 Bo.Mameyal
Dorado, Puerto Rico

Client Name and Address:
DEPARTAMENTO DE RECREACION Y DEPORTES DE PR
PO Box 9023207 San Juan
PR 00902-3207
Tel. (787) 721-2900 Fax: (787) 268-1845
www.drd.pr.gov

Design by: B. QUINONES

No.	Revision/Issue	Plot Date:

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Lic. 17715/PE
Puerto Rico
Fecha de Expiración: 2024-08-10
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In this Page:
PROPOSED DETAILS

Scale:	Details scale:
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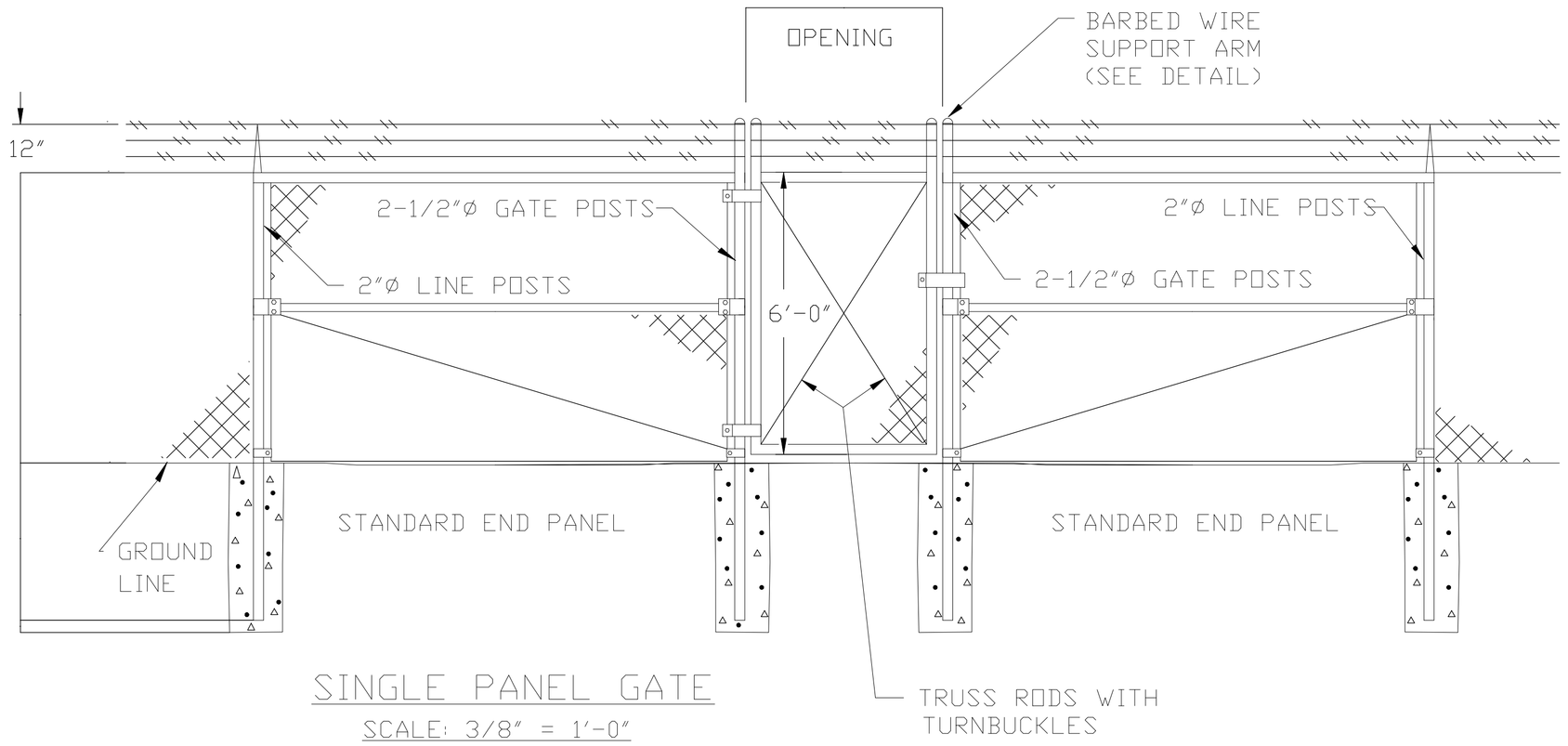
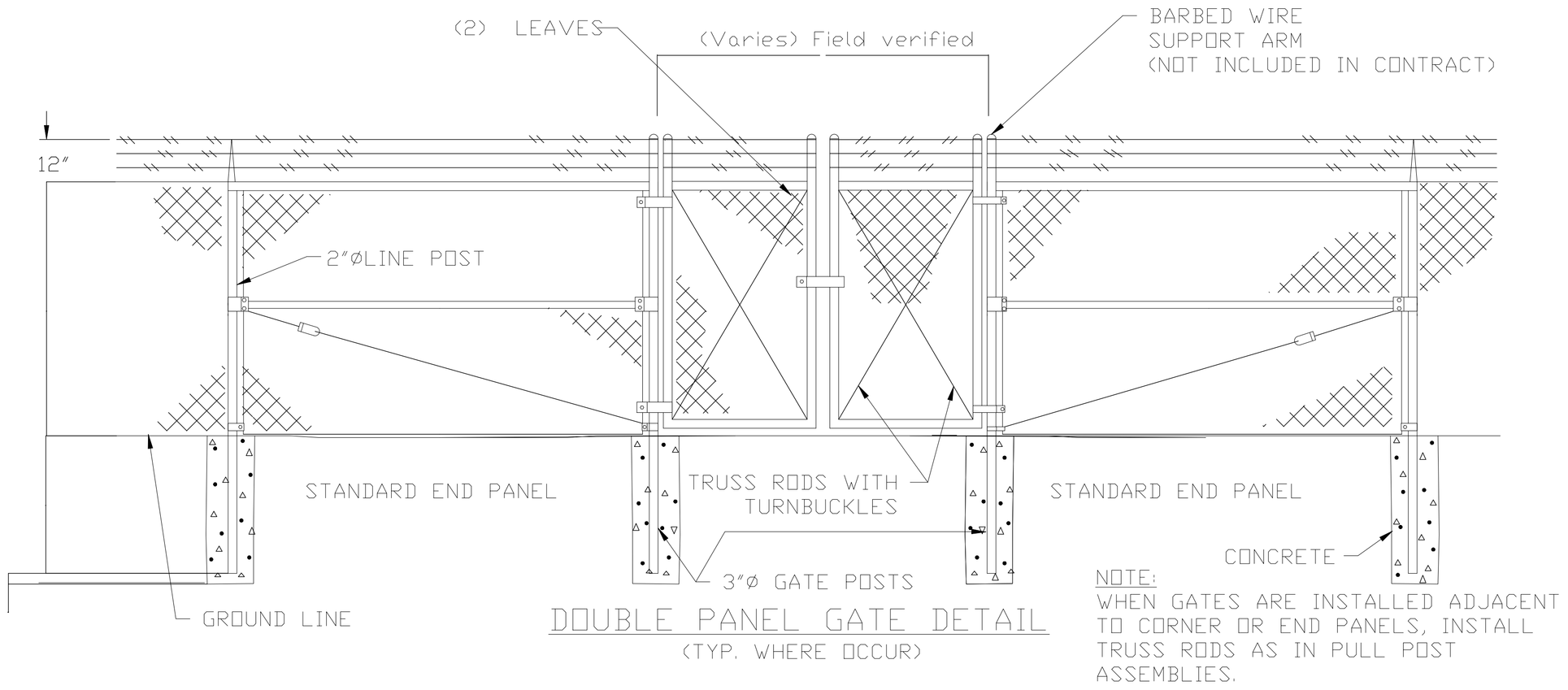
Job #: 2023-000501	Sheet No.
Date: JULY 30 2023	S-01
Check by: JULY 30 2023	



SINGLE PANEL GATE

SCALE: 3/8" = 1'-0"

NOTE:
ALL CONCRETE MUST BE 3,000 PSI



DOUBLE PANEL GATE DETAIL

(TYP. WHERE OCCUR)

NOTE:
WHEN GATES ARE INSTALLED ADJACENT TO CORNER OR END PANELS, INSTALL TRUSS RODS AS IN PULL POST ASSEMBLIES.

Existing Spalling Concrete repair (where occur)







- I - Chip the existing loose concrete and treat the exposed rebar. Clean exposed rebar with a steel brush and apply Loctite Extend Rust Neutralizer.

- II- Apply :



Sika® Armatec®-110 EpoCem

BONDING PRIMER AND REINFORCEMENT CORROSION PROTECTION

Sika® Armatec®-110 EpoCem is a cementitious epoxy resin compensated 3-component, solvent-free, coating material with corrosion inhibitor, used as bonding primer and reinforcement corrosion protection.

- ✓ Contains EpoCem® technology - improved bonding agent
- ✓ Extended open times for repair mortars
- ✓ Excellent adhesion to concrete and steel

- III – Patch and finish the affected area with Vinyl Concrete Patch.



EQUAL OR SIMILAR

SPALLING CONCRETE REPAIR

SCALE: NOT TO SCALE

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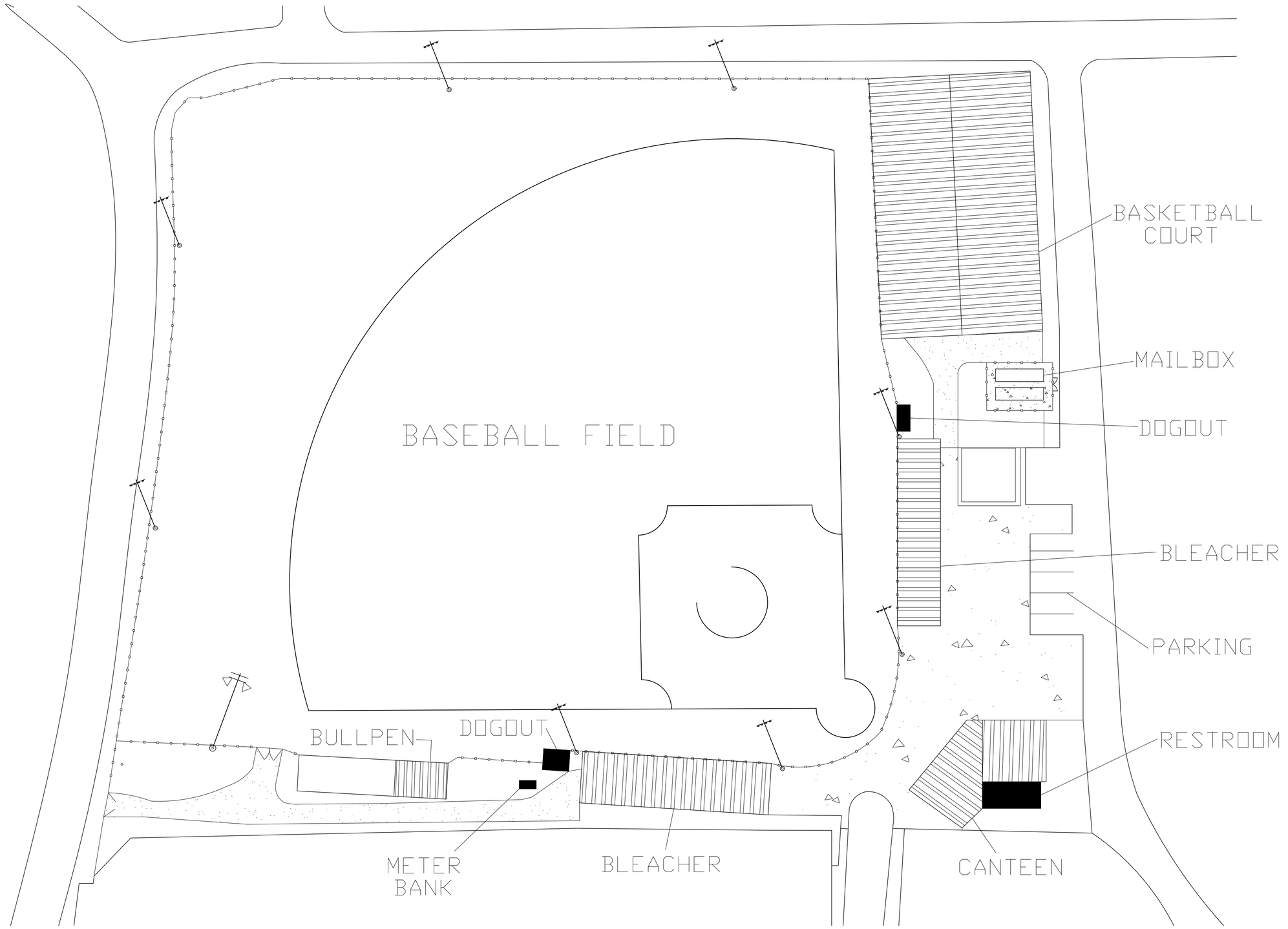
In this Page:
CHAIN LINK GATE

Scale: NOT TO SCALE
Details scale: AS NOTED

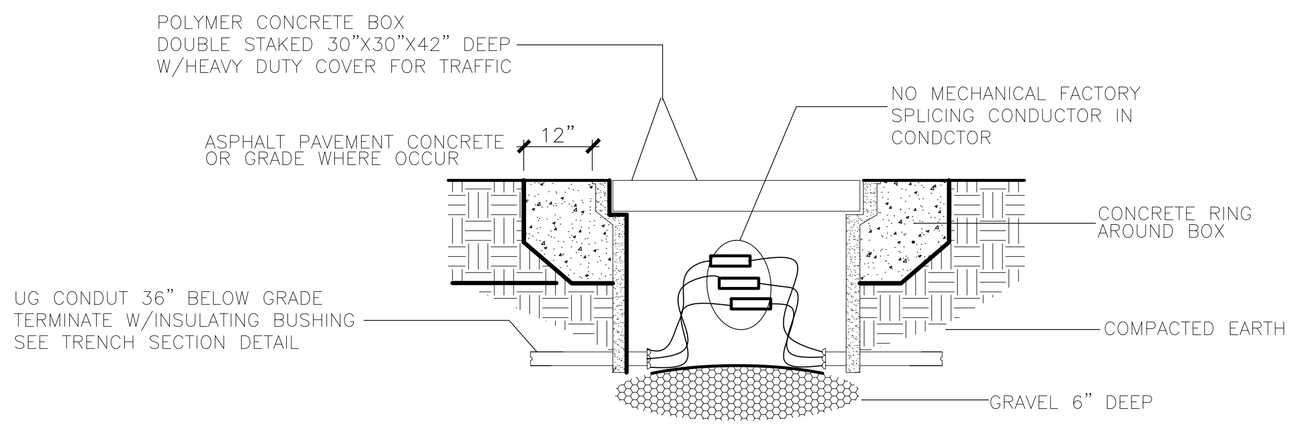
Job #: 2023-000501
Date: JULY 30 2023
Check by: JULY 30 2023

Sheet No.
S-02



PROPOSED ELECTRICAL SITE PLAN

NOT TO SCALE



PULL BOX DETAIL

NOT TO SCALE



New SQUARE D Safety Switch: 30 A Amps AC, 3 HP @ 240V AC, 3R, 2 Poles, 2 Wires EQUAL OR SIMILAR TO IMfr. Model DU221RB

SAFETY SWITCH

SCALE: NOT TO SCALE



GE Industrial Solutions TSM420CSCUP Meter Socket Load Center, 200 A, NEMA 3R Enclosure, Surface Mounting

EQUAL OR SIMILAR

NEW METER BASE

SCALE: NOT TO SCALE

NOTES:

1) As part of field lighting system, the contractor must consider the following:

A) The installation of a new meter base equal or similar to GE industrial solutions model TSM420CSCUP, 200 A, Nema 3R enclosure, surface mounting.
B) The installation of a new distribution panel, equal or similar to model Square D QO 112L125PG QO load center 125A, 1PH, 12 spaces.
C) The installation of a new Square D safety switch, 100 Amp AC, 1PH, 120 V, 3R, 3 poles, 2 wires equal or similar to model 8538SEG130V02S.
D) The contractor must install a control panel equal or similar to MUSCO control link contactor cabinet system.
E) All electrical installation must be done as per code, and regulations, and the contractor must provide an electrical certification to the owner.
F) The contractor must provide a new cad weld grounding system to each athletic pole.
G) The contractor must consider a dedicated circuit breaker for each pole.
H) The contractor must install a new 3-#4 RHHN underground electrical wiring. Use 2in min. diameter PVC SCHD. 40 conduits. See detail.

LEGEND:

Existing metal pole. New exterior luminaires, .Equal or similar model HL-SP06-500W by LED Sports Light.

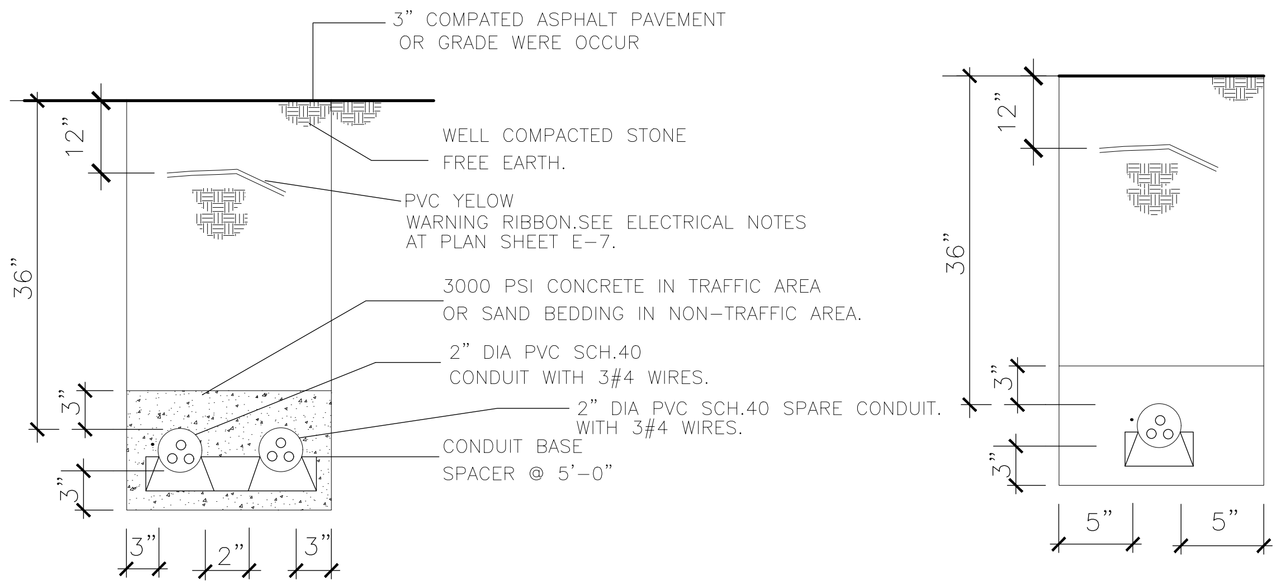
X — X — New underground electrical feeder with 3#4 RHHN. (2000LF) See Detail.

New Baseball Field Pole and Lighting System Equal or Similar to MUSCO Product as specified.

Concrete walkways

Asphalt pavement

New Pull box



SECTION X-X DETAIL

SECTION Y-Y DETAIL

TRENCH SECTION DETAIL

NOT TO SCALE

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PROPOSED ELECTRICAL SITE PLAN

Scale:	Details scale:
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Job #: 2023-000502	Sheet No.
Date: JULY 30 2023	E-01
Check by: JULY 30 2023	

GENERAL ELECTRICAL NOTES:

1. ALL WORK SHALL BE STRICTLY COORDINATED WITH OWNER'S REPRESENTATIVE, A WRITTEN NOTICE TO PROCEEDE FROM THE OWNER IS REQUIRED PRIOR START THE CONSTRUCTION WORKS. ALL MATERIALS AND INSTALLATION SHALL CONFORM TO THE OWNER'S STANDARDS AND SPECIFICATION.
2. ELECTRICAL CONTRACTOR SHALL PROVIDE ALL REQUIRED INSURANCES ACCORDING TO OWNER'S REPRESENTATIVE FOR PROTECTION AGAINST PUBLIC LIABILITY AND PROPERTY DAMAGE.
3. ALL ELECTRICAL CONSTRUCTION WORKS SHALL BE DONE IN A THOROUGH AND WORKMANLIKE MANNER BY A LICENSED CONTRACTOR FOR A FULLY OPERATIVE SYSTEM IN ACCORDANCE WITH THE PLANS, SPECS AND CONSTRUCTION DRAWINGS. THE LATEST EDITIONS OF THE NATIONAL ELECTRICAL, FIRE AND LOCAL CODES HAVING JURISDICTION SHALL BE FOLLOWED.
4. ELECTRICAL CONTRACTOR SHALL VISIT THE PROJECT PRIOR QUOTATION AND SHALL ADJUST HIS WORK TO ALL CONDITIONS FOUNDED ON SITE ACCORDING TO ARCHITECTURAL, CIVIL, STRUCTURAL, PLUMBING, MECHANICAL AND ELECTRICAL DRAWINGS. ALL ADJUSTMENTS AND CHANGES REQUIRED DUE TO EXISTING CONDITIONS SHALL BE INCLUDED IN HIS QUOTATION.
5. SPECIAL CONDITIONS APPLY TO ELECTRICAL DRAWINGS, THEY ARE SCHEMATICS. ELECTRICAL CONTRACTOR SHALL INCLUDE IN HIS QUOTATION ALL COSTS NECESSARIES TO PROVIDE A COMPLETE INSTALLATION READY FOR USE ACCORDING TO DRAWINGS AND SPECIFICATIONS.
6. ELECTRICAL CONTRACTOR SHALL COORDINATE WITH MANUFACTURER'S SUPPLIER EXACT REQUIREMENTS FOR THE INSTALLATION AND PROTECTION OF ALL ELECTRICAL EQUIPMENTS AND MATERIALS PRIOR QUOTATION. ALL EQUIPMENTS AND MATERIALS SHALL BE NEW EXCEPT UNLESS OTHERWISE INDICATED AND SHALL BEAR UNDERWRITTERS AND UNION LABLES.
7. ELECTRICAL CONTRACTOR IS RESPONSIBLE TO FURNISH AND INSTALL ALL ELECTRICAL EQUIPMENTS INCLUDING CONTROL PANELS, OUTLETS, DEVICES, WIRING, ETC. ACCORDING TO DRAWINGS UNLESS OTHERWISE INDICATED.
8. ALL DISTRIBUTION PANEL BOARDS SHALL BE CONSTRUCTED WITH A GROUND BUS SEPARATE FROM NEUTRAL ONE TO CONNECT ALL GROUNDING GREEN WIRES. CIRCUIT BREAKERS SHALL BE BOLT–ON TYPE, PLUG–IN TYPE NOT ALLOWED. PROVIDE IDENTIFICATION OF ALL BRANCH CIRCUITS ON A TYPEWRITTEN DIRECTORY CARD IN THE PANEL DOOR.
9. ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR BALANCING ALL LOADS ON DISTRIBUTION PANELBOARD. MAXIMUN LOAD FOR EACH BRANCH CIRCUITS IS EIGHTY PERCENT. (80%)
10. ALL WIRING DEVICE SHALL BE SPECIFICATION GRADE.

Area Lighting Poles

- Remove and replace existing light poles, equal or similar to Model MLLG-WL-POLE-15FT-4IN-SQ-BZ as manufactured by LED LIGHTING SUPPLY.

LED LIGHTING SUPPLY — View Product Page

15 Foot Steel Square Light Pole | 4 Inches Wide | 11 Gauge



Product Details

SKU: MLLG-WL-POLE-15FT-4IN-SQ-BZ **Web ID:** 1915

15 Foot Steel Pole 4 In Square with Top Cap Architectural bronze 11 gauge steel

Bolt Circle 8-10 in bolt size 3/4x17x3 in 4 sides predrilled and hole plugs included.

Conforms to ASTM-A 500 Grade B: Min Yield Strength-46000 PSI.

Accessories Available:

MLLG-WL-POLE-SQ-AnchorBolts - Anchor Bolts for Square Poles

MLLG-WL-POLE-SQ-ABPP - Anchor Bolts positioning plate for 4 or 5 inch pole. Needed for new installation.

MLLG-WL-POLE-4IN-SQ-BaseCover - 4 Inch Pole Square Base Cover. Dark Bronze.

MLLG-WL-POLE-SQTA-4in-BZ - Square Pole Top Tenon Adapter for 4 Inch Square to 2 3/8 Inch round - Bronze

MLLG-WD-POLE-BH-2-BZ - 2 Fixture 180 Degree Bullhorn mount - Bronze. Mounts on a 2 3/8 inch Tenon.

MLLG-WD-POLE-BH-3-BZ - 3 Fixture 180 Degree Bullhorn mount - Bronze. Mounts on a 2 3/8 inch Tenon.

MLLG-WD-POLE-BH-4-BZ - 4 Fixture 180 Degree Bullhorn mount - Bronze. Mounts on a 2 3/8 inch Tenon.

Product Specifications

Height:	15 ft	**EPA Rating 70 mph:**	15.2
Gauge:	11	**EPA Rating 80 mph:**	12.5
Size:	4 in X 4 in	**EPA Rating 90 mph:**	10.1
Finish:	Powder Coated Bronze	**EPA Rating 100 mph:**	8.5
Weight:	117 lbs	**EPA Rating 110 mph:**	6.9
Bolt Circle:	8 in - 10 in	**EPA Rating 120 mph:**	5.4</tbody>
Bolt Projection:	2.75 in</tbody>		

AREA LIGHTING POLE

SCALE: NOT TO SCALE

SYLVANIA Luminaires

ValueLED™ UFO 2A High Bay



Application

An environmentally preferable alternative to traditional luminaires and offering up to 70% energy savings, the ValueLED UFO 2A High Bay is ideal for illuminating warehouses, gymnasiums, and other industrial applications.

Benefits and Features

- Lightweight fixture is designed for easy and safe installation
- NSF Splash Zone rated
- Multiple mounting options for a variety of applications - pendant, hook, surface mount
- All fixtures ship with a sensor base pre-wired to a small junction box so they are ready to accept the optional, field installable, screw-in microwave motion/daylight sensor with no wiring required - sensor installs in seconds
- Mounting hook included
- 90° polycarbonate front lens minimizes glare
- Variety of optics - polycarbonate refractor and aluminum reflector available
- IP65 rated aluminum body (finish is white or black)
- Up to 145 LPW
- 4000K and 5000K color temperatures
- CRI >80
- Offered in 100, 150, 200, and 240 watts

Electrical

- Designed to operate through 120-277V (VAC) or 277-480 (VAC) Vac voltage
- Power Factor >90%
- THD <20%
- 0-10V dimming
- Constant current LED driver with 6kV surge suppression
- UL Wet Rated

Rated Life

- ≥ 150,000 hours (L70) @25°C

Warranty

- 5-year
- NLB Trusted Warranty Program

Ambient Operating Range

- -40°F to +122°F (-40°C to +50°C)

Wattage Comparison

Traditional Source	Traditional System Wattage	LED System Wattage	Energy Savings
250W MH	295W	100W	66%
250W HPS	295W	100W	66%
320W MH	370W	150W	59%
750W HPS	820W	300W	63%
750W MH	840W	300W	64%
1000W MH	1080W	300W	72%
1000W HPS	1100W	300W	73%

Certifications and Listings

- cULus
- RoHS
- FCC
- NSF
- DLC 5.1 Premium

Installation

- Luminaire can be hung via included hook, or can be surface or pendant mounted using optional mounting brackets.
- Aluminum reflector, polycarbonate refractor, and polycarbonate bottoms lens are available.
- Includes 6' power cable and 3' dimming cable.
- Polycarbonate refractor and polycarbonate bottom lens have an IK08 rating.
- Optional whip guards are available
- Unscrew plug in the center of the lens to screw in the optional motion/daylight sensor by hand - no wiring required

LEDLUM107R1 11-21

BASKETBALL COURT LIGHTING

SCALE: NOT TO SCALE

GL16INC 16 Inch Globe Fixture with Medium Socket. Bulb Not Included

Energy Light, Inc. 1881 Rose Road, Lake Zurich, Illinois • (224) 539-8285

© 2022 Energy Light, Inc. All rights reserved. • Specifications subject to change without notice.

Product Description

This outdoor globe fixture is designed to fit over a 3" pole or tenon. The base slides over a 3" O.D. pole and is locked-in place with 3 set screws. The globe is attached to the base assembly with an easy-to-use locking mechanism making replacement of the bulb or globe very easy. Polycarbonate base assembly with the socket comes in 2 colors: Black or white. The globe is made of acrylic and is available only in white color.

Product Specifications

Power: 120V only

Diameter: 16 inch

Overall Height: 16.25 inch

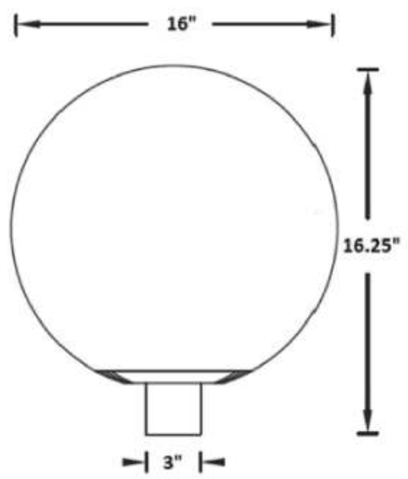
EPA: 0.87

Weight: 3 lbs.

Warranty: 5 Years

Suitable for outdoor use.





AREA LIGHTING

SCALE: NOT TO SCALE

SYLVANIA Luminaires

ValueLED™ Area Light 3A

EQUAL OR SIMILAR

Application

The SYLVANIA ValueLED Area Light 3A luminaires are the perfect alternative to traditional lighting technologies, offering a variety of solutions to illuminate parking lots, parking garage roofs and general area lighting.

Benefits and Features

- IP66 rated body offered in a modern and sleek design
- Each luminaire ships with a universal mounting accessory for round/square pole mounting and tenon mounting
- DLC Premium listed to maximize rebate opportunities
- Integrated 3 pin photocontrol receptacle compatible with Standard NEMA photo cell. Shorting cap included
- Up to 135 LPW
- 4000K and 5000K color temperatures
- CRI > 70
- Offered in 150 and 300 watts
- Type III and V distribution
- Energy savings up to 73%

Electrical

- 120-277VAC
- Power Factor >90%
- THD <20%
- 0-10V dimmable

Optical

- Lens is polycarbonate

Rated Life

- 100,000 hours (L_{70}) @25°C

Warranty

- 5-year

Ambient Operating Range

- -40°F to +102°F (-40°C to +40°C)



Wattage Comparison

Traditional Source	Traditional System Wattage	LED System Wattage	Energy Savings
250W MH	295W	150W	46%
250W HPS	295W	150W	49%
320W MH	370W	150W	59%
750W HPS	820W	300W	63%
750W MH	840W	300W	64%
1000W MH	1080W	300W	72%
1000W HPS	1100W	300W	73%

Certifications and Listings

- cULus
- RoHS
- FCC
- IP66
- DLC Premium

Installation

- Each luminaire ships with a universal mounting accessory for round/square pole mounting

BASKETBALL COURT EXTERIOR LIGHTING

SCALE: NOT TO SCALE

ON KEY LLC

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Design by: B. QUINONES

No.	Revision/Issue	Plot Date:

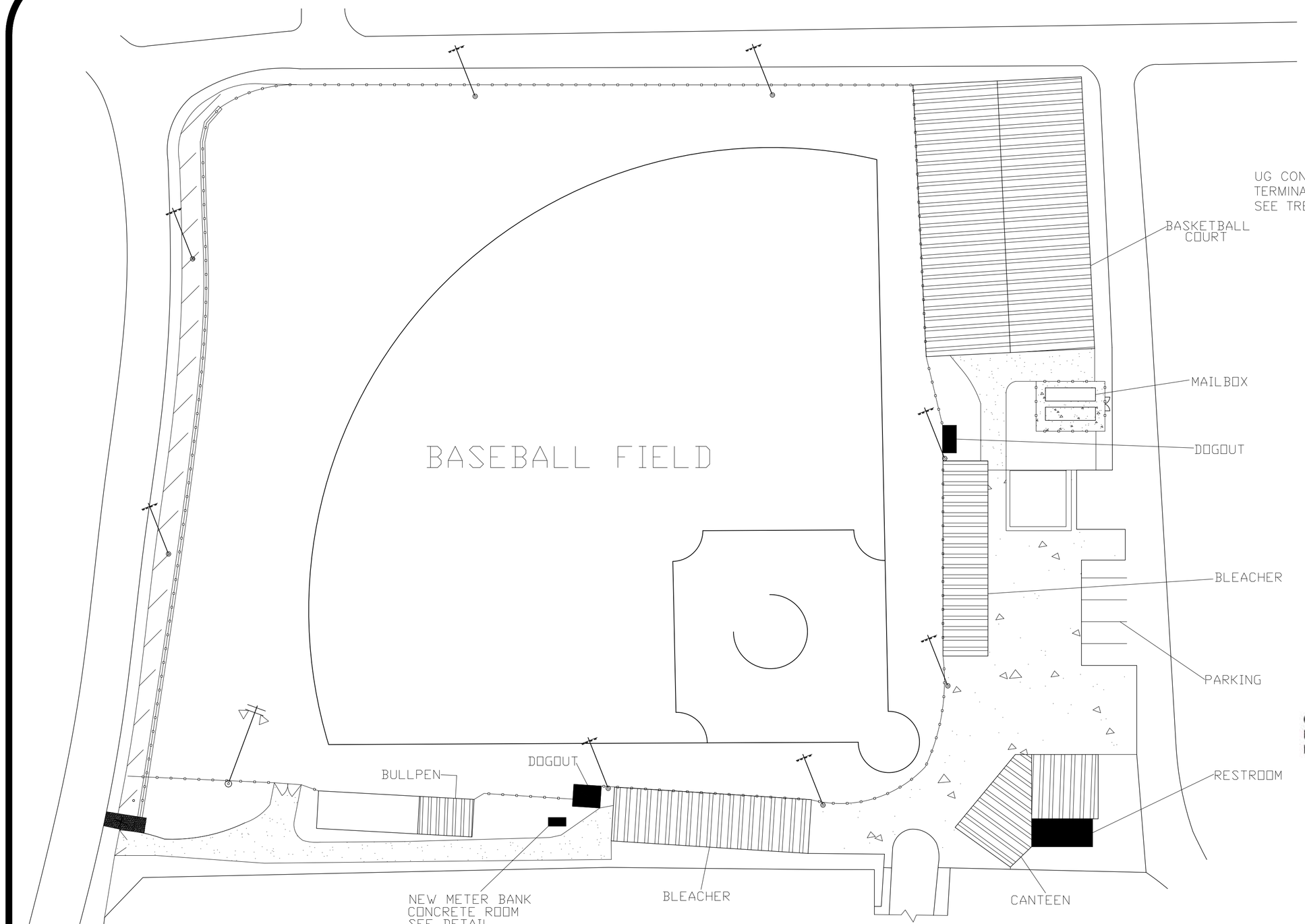
Brendaly Quiñones Villodas
Ingeniero Licenciado
Lic. 17715 PR
Puerto Rico
Fecha de Expiración: 2024-06-10
HARD COPY SIGNATURE AND SEAL
ENG. BRENDALY QUIÑONES Lic. # 17715

DRD
DEPARTAMENTO DE RECREACIÓN Y DEPORTES
PO Box 9023207
San Juan PR
00902–3207

In this Page:
PROPOSED LIGHTING FIXTURES AND NOTES

Scale: NOT TO SCALE
Details scale: AS NOTED

Job #: 2023–000502
Date: JULY 30 2023
Check by: JULY 30 2023
Sheet No.
E-02



PROPOSED ELECTRICAL SITE PLAN

NOT TO SCALE



EXISTING METER BASE TO BE DEMOLISHED

SCALE: NOT TO SCALE



EXISTING OUTDOOR GYM FIXTURE TO BE REPLACED

SCALE: NOT TO SCALE

NOTES:

1) As part of field lighting system, the contractor must consider the following:

A) The installation of a new meter base equal or similar to GE industrial solutions model TSM420CSCUP, 200 A, Nema 3R enclosure, surface mounting.
B) The installation of a new distribution panel, equal or similar to model Square D QO 112L125PG QO load center 125A, 1PH, 12 spaces.
C) The installation of a new Square D safety switch, 100 Amp AC, 1PH, 120 V, 3R, 3 poles, 2 wires equal or similar to model 8538SEG130V02S.
D) The contractor must install a control panel equal or similar to MUSCO control link contactor cabinet system.
E) All electrical installation must be done as per code, and regulations, and the contractor must provide an electrical certification to the owner.
F) The contractor must provide a new cad weld grounding system to each athletic pole.
G) The contractor must consider a dedicated circuit breaker for each pole.
H) The contractor must install a new 3-#4 RHHN underground electrical wiring. Use 2in min. diameter PVC SCHD. 40 conduits. See detail.

LEGEND:

Existing metal pole. New exterior luminaires, .Equal or similar model HL-SP06-500W by LED Sports Light.

New underground electrical feeder with 3#4 RHHN. (2000LF) See Detail.

New Baseball Field Pole and Lighting System Equal or Similar to MUSCO Product as specified.

Concrete walkways

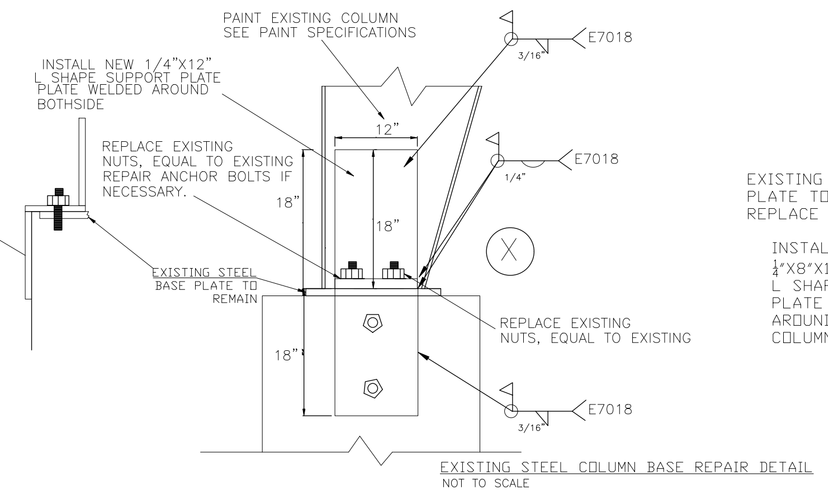
Asphalt pavement

New Pull box



EXISTING COLUMN

NOT TO SCALE

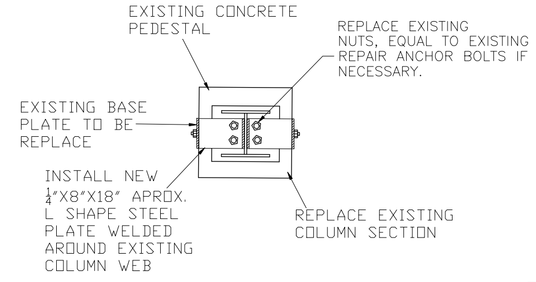


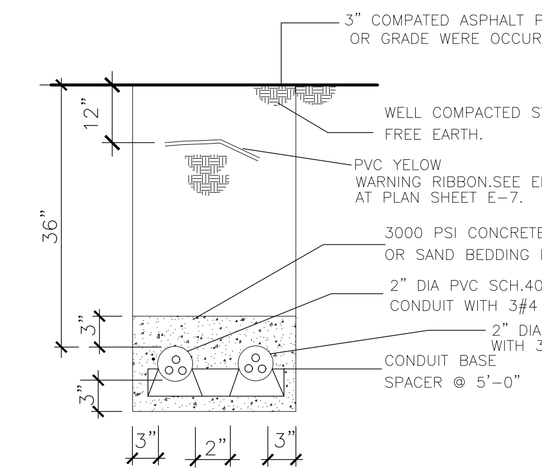
EXISTING STEEL COLUMN BASE REPAIR DETAIL

NOT TO SCALE

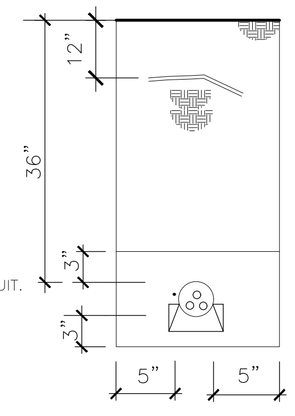
EXISTING COLUMN REPAIR

SCALE: NOT TO SCALE





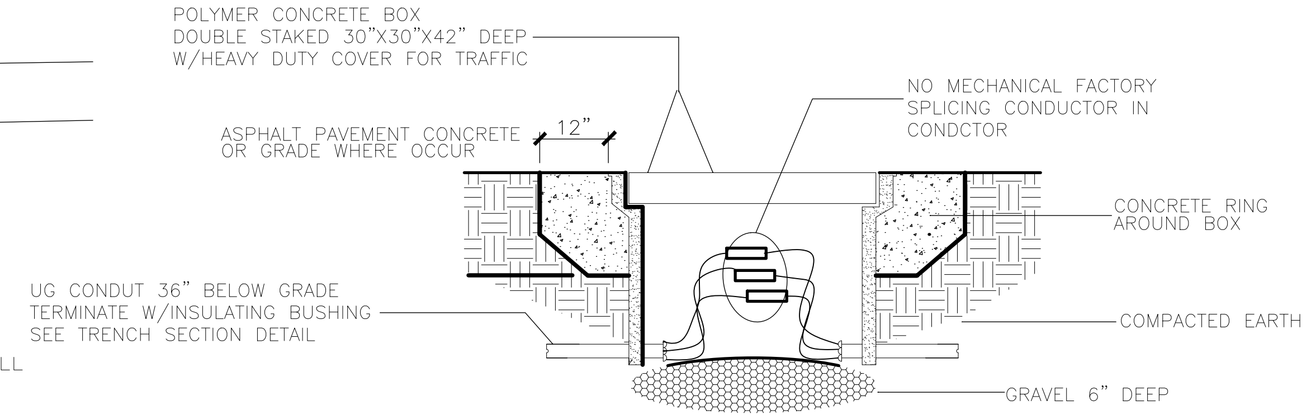
SECTION X-X DETAIL



SECTION Y-Y DETAIL

TRENCH SECTION DETAIL

NOT TO SCALE



INSTALL NEW SYSTEM EQUAL OR TO MUSCO LIGHTING SYST.

- (2) 70' Galvanized Steel Poles
- (2) 50' Galvanized Steel Poles
- (4) 60' Galvanized Steel Poles
- (8) Pre-cast concrete bases
- (6) TLC-BT-575
- (22) TLC-LED-1200
- (6) TLC-LED-900
- (1) Control-Link Cabinet

FIELD LIGHTING SYSTEM

SCALE: NOT TO SCALE

PULL BOX DETAIL

NOT TO SCALE



EQUAL OR SIMILAR TO GE LOAD CENTER MODEL TLM4020RCU, 200 A, NEMA 3R 1PH, 30 SPACES. SURFACE MOUNTED. THE CONTRACTOR MUST CONSIDERED ALL NEEDED CIRCUIT BREAKERS (8EA-40AMP AND. 2EA - 20AMP)

DISTRIBUTION PANEL

SCALE: NOT TO SCALE



New GE, 200 Amp AC, 1PH, 120/240 V, 3R 3 poles, 2 wires, non-fused equal or similar to model TGN3324R

DISCONNECT SWITCH

SCALE: NOT TO SCALE



EXISTING METER BASE. REPLACE EXISTING LOAD CENTER AND CIRCUIT BREAKERS

SCALE: NOT TO SCALE

GE Industrial Solutions TSM420CSCUP Meter Socket Load Center, 200 A, NEMA 3R Enclosure, Surface Mounting

EQUAL OR SIMILAR

NEW METER BASE

SCALE: NOT TO SCALE

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Design by: B. QUINONES

No.	Revision/Issue	Plot Date:

Brendaly Quiñones Villodas
Ingeniero Licenciado
Lic. 17715 PE
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Fecha de Expiración: 2024-06-10
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San Juan PR
00902-3207

In this Page:

ADDENDUM NO.3
PROPOSED ELECTRICAL SITE PLAN

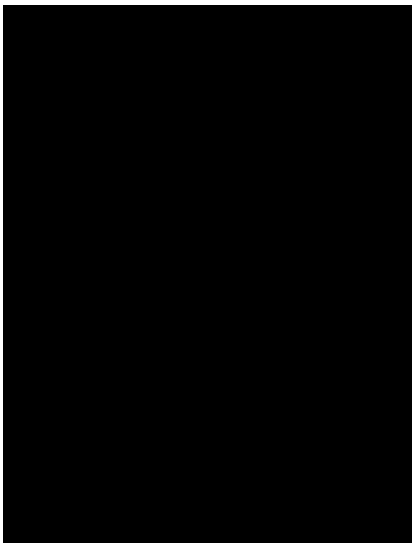
Scale:	Details scale:
NOT TO SCALE	AS NOTED

Job #: 2023-000502	Sheet No.
Date: JULY 30 2023	E-01
Check by: SEP. 10 2024	



General Technical Specifications

Parque Félix García Facility Repairs, Dorado, Puerto Rico



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SECTION 02220

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SECTION 02220

DEMOLITION

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 in the text by basic designation only.

ENGINEERING MANUALS (EM)

1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data Work

Plan; G, [_____]

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property

which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.5.2 Protection of Structures

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, of lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.4 Protection From the Weather

The interior of buildings to remain; salvageable materials and equipment shall be protected from the weather at all times.

1.5.5 Protection of Trees

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 1.8 m (6 foot) 6 foot high fence. The fence shall be securely erected a minimum of 1.5 m 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.5.6 Environmental Protection

The work shall comply with the requirements of Section [01410 ENVIRONMENT PROTECTION] [_____].

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris [will not be permitted] [will be permitted in the area located [_____] and between the hours of [_____] and [_____]].

1.7 USE OF EXPLOSIVES

Use of explosives [will] [will not] be permitted.

1.8 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with the following schedule:

Area	Date
[_____]	[_____]

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated shall be removed [to grade] [to top of foundation walls] [to [_____] meters feet below grade]. Interior walls, other than retaining walls and partitions, shall be removed to [_____] meters feet below grade or to top of concrete slab on ground. Basement slabs shall be broken up to permit drainage. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

3.2 UTILITIES

Disconnection of utility services, with related meters and equipment, are specified in Section [_____]. Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section [_____] [as follows: [_____]].

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.4.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4.1.2 Items Salvaged for the Government

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents. The following items reserved as property of the Government shall be delivered to the areas designated: [____].

3.4.1.3 Items Salvaged for the Using Service

The following items reserved as property of the using service shall be removed prior to commencement of work under this contract: [_____].

3.4.1.4 Historical Items

Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.4.2 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in the disposal area located [_____]. The fill in the disposal area shall remain below elevation [_____] and after disposal is completed, the disposal area shall be uniformly graded to drain. Combustible material shall be disposed of [in the sanitary fill area located [_____]] [off the site] [by burning].

3.5 CLEAN UP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.6 PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings and to the limits and [depths indicated on the drawings] [to a depth of [_____] mm inches].

-- End of Section --

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-- End of Section Table of Contents

SECTION 02230

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 75 mm 3 inches in diameter, and matted roots from the designated grubbing areas.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Materials Other Than Salable Timber; [_____], [_____]

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

1.3 MEASUREMENT

1.3.1 Measured Clearing

Clearing shall be measured in acres of clearing actually performed. Areas of light brush, shrubs, and other vegetation that can be cut with a brush hook, scythe, or mowing machine shall not be measured as clearing.

1.3.2 Measured Grubbing

Grubbing shall be measured in acres of grubbing actually performed. Areas where tree roots and timber are less than 75 mm 3 inches in diameter and areas where roots of brush, shrubs, and other vegetation can be removed by plowing shall not be measured as grubbing.

1.3.3 Measured Clearing and Grubbing

Clearing and grubbing shall be measured in hectares acres of clearing and grubbing actually performed.

1.3.4 Measured Tree Removal

Tree removal shall be measured by the number of trees of stated sizes removed from areas outside the clearing and grubbing areas. The size shall be determined by the average diameter of the trunk 1 m 4 feet above the ground line. The size of stumps designated for removal as trees shall be determined by the diameter of the trunk 1 m 4 feet above the ground line. The diameter shall be measured to the nearest 25 mm.full inch.

1.4 PAYMENT

1.4.1 Paid Clearing

Payment for clearing will be made at the contract unit price per hectare acre for clearing, and this price shall constitute full compensation for all labor, equipment, tools, and incidentals necessary to complete the work specified herein.

1.4.2 Paid Grubbing

Payment for grubbing will be made at the contract unit price per hectare acre for grubbing, and this price shall constitute full compensation for all labor, equipment, tools, and incidentals necessary to complete the work specified herein.

1.4.3 Paid Clearing and Grubbing

Payment will be made at the contract unit price for clearing and grubbing, and this price shall constitute full compensation for all labor, equipment, tools, and incidentals necessary to complete the work specified herein.

1.4.4 Paid Tree Removal

Payment for tree removal will be made at the contract unit price for removing trees, or stumps designated as trees, that are outside the area designated for clearing or grubbing in accordance with the following schedule of sizes:

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 40 mm 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 40 mm 1-1/2 inches in diameter

shall be painted with an approved tree-wound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require. [Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work.]

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 455 mm 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 DISPOSAL OF MATERIALS

3.4.1 Salable Timber

All felled timber from which saw logs, pulpwood, posts, poles, ties, mine props, or cordwood can be produced shall be considered as salable timber, and shall be trimmed of limbs and tops, sawed into salable lengths of [___] meters, feet, and stockpiled at locations as directed. The disposal of the stockpiled timber will be by the Government.

3.4.2 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of [in the designated waste disposal area] [outside the limits of Government-controlled land at the Contractor's responsibility] [by burning], except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed. [Refuse to be burned shall be burned at specified locations and in a manner to prevent damage to existing structures and appurtenances, construction in progress, trees, and other vegetation. The Contractor shall be responsible for compliance with all Federal and State laws and regulations and with reasonable practice relative to the building of fires. Burning or other disposal of refuse and debris and any accidental loss or damage attendant thereto shall be the Contractor's responsibility.]

-- End of Section --

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SECTION 02316

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-- End of Section Table of Contents --

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 in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1.2 MEASUREMENT AND PAYMENT

Measurement and payment shall be based on completed work performed in accordance with the drawings and specifications.

1.2.1 Trench Excavation

Trench excavation shall be the number of linear meters feet measured along the centerline of the trench and excavated to the depths and widths specified for the particular size of pipe. No increase shall be made for the extra width required at manholes and similar structures. Payment for trench excavation, as so measured, shall constitute full payment for excavation and backfilling, [including specified overdepth] except in rock or unstable trench bottoms. Unstable trench bottoms shall be replaced by select granular material and paid for as specified below. Trench excavation shall also include the additional width at manholes and similar structures, the furnishing, placing and removal of sheeting and bracing, pumping and

bailing, and all incidentals necessary to complete the work required by this section.

1.2.2 Rock Excavation

Rock excavation shall be measured and paid for by the number of cubic meters yards of acceptably excavated rock material. The material shall be measured in place, but volume shall be based on a maximum 750 mm 30 inch width for pipes 300 mm (12 inches) 12 inches in diameter or less, and a maximum width of 400 mm 16 inches greater than the outside diameter of the pipe for pipes over 300 mm (12 inches) 12 inches in diameter. The measurement shall include all authorized overdepth rock excavation as determined by the Contracting Officer. For manholes and other appurtenances, volumes of rock excavation shall be computed on the basis of 300 mm 1 foot outside of the wall lines of the structures. Payment for rock excavation will be made in addition to the price bid for the trench excavation, and will include all necessary drilling and blasting and all incidentals necessary to excavate and dispose of the rock. Backfill replacing rock excavation will not be paid for separately, but will be included in the unit price for rock excavation.

1.2.3 Sheeting and Bracing

Sheeting and bracing, when shown or authorized by the Contracting Officer to be left in place, will be paid for as follows: [_____].

1.2.3.1 Timber Sheeting

Timber sheeting will be paid for as the number of board feet of lumber below finish grade measured in place prior to backfilling. Sheeting wasted when cut off between the finished grade and 300 mm 1 foot below the finished grade also shall be included in the measurement.

1.2.3.2 Steel Sheeting and Soldier Piles

Steel sheeting, soldier piles, and steel bracing will be paid for according to the number of pounds of steel calculated. This calculation shall be made by multiplying the measured in-place length in meters feet below finish grade by the unit weight of the section in kg per meter. pounds per foot. Unit weight of rolled steel sections shall be obtained from recognized steel manuals. [Sheeting wasted when cut off between the finished grade and a distance of up to [_____] meters feet below the finished grade shall be included in the measurement.]

1.2.4 Select Granular Material

Select granular material shall be measured in place as the actual cubic meters yards replacing wet or unstable material in trench bottoms [within the limits shown] [in authorized overdepth areas]. The unit price shall include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work. Payment for select granular material will be made in addition to the bid price for trench excavation.

1.3 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Field Density Tests; [_____], [_____]
Testing of Backfill Materials; [_____], [_____]

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, [SM,] [SW-SM,] [SC,] [SW-SC,] [SP-SM,] [SP-SC,] [CL,] [ML,] [CL-ML,] [CH,] [MH].

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than [_____] mm inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

2.1.4 Rock

Rock shall consist of boulders measuring 1/2 cubic meter 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic meter 1/2 cubic yard in volume, except that pavements shall not be considered as rock.

2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than [_____] millimeters inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a 0.075 mm No. 200 mesh sieve and no less than 95 percent by weight passing the 25 mm 1 inch sieve. The maximum allowable aggregate size shall be [_____] millimeters, inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks [_____] millimeters inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than [_____] millimeters inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 152 mm (6 inches) 6 inches wide with minimum thickness of 0.102 mm (0.004 inch). 0.004 inch. Tape shall have a minimum strength of 12.1 MPa (1750 psi) 1750 psi lengthwise and 10.3 MPa (1500 psi) 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 1 meter 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 600 mm. 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site [or shall be disposed of by [_____]]. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.1.1 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than [_____] meters feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than [_____] meters feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 600 mm (24 inches) 24 inches plus pipe outside diameter (O.D.) for pipes of less than 600 mm (24 inches) 24 inches inside diameter and shall not exceed 900 mm (36 inches) 36 inches plus pipe outside diameter for sizes larger than 600 mm (24 inches) 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of [_____] millimeters inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where [overdepth is not indicated and] unyielding material is encountered in the bottom of the trench, such material shall be removed [_____] millimeters

inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be [sufficient to leave at least 300 mm 12 inches clear between the outer structure surfaces and the face of the excavation or support members] [of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown.] Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.1.2 Stockpiles

Stockpiles of satisfactory [and unsatisfactory] [and wasted materials] shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. [Locations of stockpiles of satisfactory materials shall be
[as shown] [subject to prior approval of the Contracting Officer].]

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 150 mm 6 inches loose thickness for compaction by hand operated machine compactors, and 200 mm 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. [The trench shall be backfilled to [_____] meters feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.] [The trench shall not be backfilled until all specified tests are performed.]

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm 6 inches loose thickness.

3.2.1.3 Bedding and Initial Backfill

[Bedding shall be of the type and thickness shown.] Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways, Railroads, and Airfields: Backfill shall be placed up to the elevation at which the requirements in Section 02300 EARTHWORK control. Water flooding or jetting methods of compaction will not be permitted.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 300 mm 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. [Water flooding or jetting methods of compaction will be

permitted for granular noncohesive backfill material. Water jetting shall not be allowed to penetrate the initial backfill.] [Compaction by water flooding or jetting will not be permitted.] This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed [and the concrete has been allowed to cure for [_____] days], backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 450 mm 18 inches of cover in rock excavation and not less than 600 mm 24 inches of cover in other excavation. Trenches shall be graded as specified for pipe-laying requirements in Section 02556 GAS DISTRIBUTION SYSTEM.

3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of [_____] meters feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. [For fire protection yard mains or piping, an additional [_____] millimeters inches of cover is required.]

3.3.3 Heat Distribution System

Initial backfill material shall be free of stones larger than 6.3 mm 1/4 inch in any dimension.

3.3.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 600 mm 24 inches from the finished grade, unless otherwise indicated. [Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.]

3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of [450] [18] [_____] millimeters inches below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer.

3.4.2 Testing of Backfill Materials

Classification of backfill materials shall be determined in accordance with ASTM D 2487 and the moisture-density relations of soils shall be determined in accordance with ASTM D 1557. A minimum of one soil classification and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every [_____] meters feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic meters 1500 cubic yards of material used. Field in-place density shall be determined in accordance with [ASTM D 1556] [ASTM D 2167] [ASTM D 2922]. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to [[_____] meters feet above the top of the pipe] [the finished grade surface], the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 900 mm (36 inches) 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows

poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

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SECTION 03200

CONCRETE REINFORCEMENT

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 in the text by basic designation only.

ACI INTERNATIONAL (ACI)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

AMERICAN WELDING SOCIETY (AWS)

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement; [_____], [_____]

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-03 Product Data

Welding; [_____], [_____]

A list of qualified welders names.

SD-07 Certificates

Reinforcing Steel; [_____], [_____]

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 WELDING

Welders shall be qualified in accordance with AWS D1.4. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M as appropriate.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to [ASTM A 185] [ASTM A 496] [ASTM A 497]. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A 884/A 884M.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 100 by 100 mm 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 13 mm 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

2.7 SYNTHETIC FIBER REINFORCEMENT

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 50 mm. 2 inches.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318M ACI 318/318R. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318M ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318M ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318M ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 150 mm. 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 50 mm. 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall

be wired or clipped together at laps at intervals not to exceed 1.2 m. 4 feet. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.4 SYNTHETIC FIBER REINFORCED CONCRETE

Fiber reinforcement shall be added to the concrete mix in accordance with the applicable sections of ASTM C 1116 and the recommendations of the manufacturer, and in an amount of [0.1] [_____] percent by volume.

3.5 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

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SECTION 05090

WELDING, STRUCTURAL

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 in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

AMERICAN WELDING SOCIETY (AWS)

1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC ASD Spec unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.3.1 Pre-erection Conference

A pre-erection conference shall be held, prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using prequalified procedures). Attendees shall include all Contractor's welding production and inspection personnel and appropriate Government personnel. Items for discussion could include: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.3.2 Mock-up Model

The field-welded connection designated as the mock-up model on the drawings shall be the first connection made. All welders qualified and designated to perform field-welded groove joints shall be present during the welding of the mock-up model connections and each one shall perform a part of the welding. The mock-up test shall simulate the physical and environmental conditions that will be encountered during the welding of all groove joints. All inspection procedures required for groove welded joints, including NDE tests, shall be performed on the mock-up model. All Contractor inspection and testing personnel that will perform QC of groove welded joints shall be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection shall be the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these groove welded joints.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Welding Procedure Qualifications; G, [_____]
Welder, Welding Operator, and Tacker Qualification; [_____], [___]
Inspector Qualification; [___], [___]
Previous Qualifications; [___], [___]
Prequalified Procedures; [_____], [_____]

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control; [_____], [_____]

A quality assurance plan and records of tests and inspections.

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1 and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1, this specification governs.

1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1 will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with

AWS D1.1. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1 and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.

d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspector qualifications shall be in accordance with AWS D1.1. Nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1 and AISC ASD Spec. When AWS D1.1 and the AISC ASD Spec specification conflict, the requirements of AWS D1.1 shall govern.

3.1.2 Identification

Welds shall be identified in one of the following ways:

a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.

b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 1 meter 3 foot intervals. Identification with die stamps or electric etchers shall not be allowed.

3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. The Contractor shall perform visual [and] [radiographic,] [ultrasonic,] [magnetic particle,] [and] [dye penetrant] inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," shall be employed.

3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1 and the contract drawings. Nondestructive testing shall be by visual inspection [and radiographic,] [ultrasonic,] [magnetic particle,] [or] [dye penetrant] methods. The minimum extent of nondestructive testing shall be random [_____] percent of welds or joints, as indicated on the drawings.

3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 Destructive Tests

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding

procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1 and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to ensure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

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SECTION 05300

STEEL DECKING

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 in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

AMERICAN WELDING SOCIETY (AWS)

STEEL DECK INSTITUTE (SDI)

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Deck Units; [_____], [_____]
Accessories; [_____], [_____]
Attachments; [_____], [_____]
Holes and Openings; [_____], [_____]

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded [or fastener] connections; and the manufacturer's erection instructions.

SD-03 Product Data

Deck Units; [_____], [_____]

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

Attachments; [_____], [_____]

Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.

SD-04 Samples

Deck Units; [_____], [_____]
Accessories; [_____], [_____]

A 0.19 sq meter 2 sq. ft. sample of the decking material to be used, along with a sample of each of the accessories used. A sample of acoustical material to be used shall be included.

SD-07 Certificates

Deck Units; [_____], [_____]
Attachments; [_____], [_____]

Manufacturer's certificates attesting that the decking material meets the specified requirements. Manufacturer's certificate attesting that the operators are authorized to use the low-velocity piston tool.

1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 DECK UNITS

Deck units shall conform to SDI Pub No 29. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span 3 or more supports with flush, telescoped, or nested 50 mm 2 inchlaps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI Cold-Formed Mnl, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

2.1.1 Roof Deck

Steel deck used in conjunction with insulation and built-up roofing shall conform to ASTM A 792/A 792M, ASTM A 611 or ASTM A 792/A 792M. Roof deck units shall be fabricated of [[0.75] [_____] mm [0.0295] [_____] inch design thickness or thicker steel] [the steel design thickness required by the design drawings] and shall be [shop painted] [galvanized] [painted with an epoxy coating or equivalent applied to prime-coating in accordance with manufacturer's standard] [zinc-coated in conformance with ASTM A 653/A 653M, G90 coating class or aluminum-zinc coated in accordance with ASTM A 792/A 792M Coating Designation AZ55].

2.1.2 Acoustical Deck Units

Deck shall have a noise reduction coefficient of [_____] when measured in accordance with ASTM C 423 using ASTM E 795 Mounting Type F-25. Sound absorbing materials shall be either [glass fiber in roll or premolded form for acoustical steel deck (noncellular)] [and] [or] [glass fiber rigid strip for acoustical steel deck (cellular)] in accordance with manufacturer's standards.

2.1.3 Composite Deck

Deck to receive concrete as a filler or for composite deck assembly shall conform to ASTM A 653/A 653M or ASTM A 611. Deck used as the tension reinforcing in composite deck shall be fabricated of [[0.75] [_____] mm [0.0295] [_____] inch design thickness or thicker steel] [the steel design thickness required by the design drawings], and shall be zinc-coated in conformance with ASTM A 653/A 653M, [G60][G90] coating class. Deck units used in composite deck shall have adequate embossment to develop mechanical shear bond to provide composite action between the deck and the concrete.

2.1.4 Form Deck

Deck used as a permanent form for concrete shall conform to ASTM A 653/A 653M or ASTM A 611. Deck used as a form for concrete shall be fabricated of [[0.38] [_____] mm [0.015] [_____] inch design thickness or thicker steel] [the steel design thickness required by the design drawings], and shall be [painted with one coat of manufacturer's standard paint] [zinc-coated in conformance with ASTM A 653/A 653M, [G60][G90] coating class.]

2.1.5 Sump Pans

Sump pans shall be provided for roof drains and shall be minimum 2 mm 0.075 inch thick steel, [flat] [recessed] type. Sump pans shall be shaped to meet roof slope by the supplier or by a sheet metal specialist. Bearing flanges of sump pans shall overlap steel deck a minimum of 75 mm. 3 inches. Opening in bottom of pan shall be shaped, sized, and reinforced to receive roof drain.

2.1.6 Shear Connectors

Shear connectors shall be [headed stud type, ASTM A 108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC ASD Spec] [and] [or] [strap type, ASTM A 570/A 570M, Grade D, hot-rolled carbon steel].

2.2 TOUCH-UP PAINT

Touch-up paint for shop-painted units shall be [of the same type used for the shop painting] [_____], and touch-up paint for zinc-coated units shall be [an approved galvanizing repair paint with a high-zinc dust content] [_____]. Welds shall be touched-up with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

2.4 CLOSURE PLATES

2.4.1 Closure Plates for Roof Deck

Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at parapets, end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.

2.4.2 Closure Plates for Composite Deck

The concrete shall be supported and retained at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Metal closures shall be provided for all openings in composite steel deck 6 mm 1/4 inch and over, including but not limited to:

2.4.2.1 Cover Plates to Close Panels

Cover plates to close panel edge and end conditions and where panels change direction or abut. Butt joints in composite steel deck may receive a tape joint cover.

2.4.2.2 Column Closures to Close Openings

Column closures to close openings between steel deck and structural steel columns.

2.4.2.3 Sheet Metal

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.5 ACCESSORIES

The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: saddles, 1.204 mm (0.0474 inch); 0.0474 inch; welding washers, 1.519 mm (0.0598 inch); 0.0598 inch; cant strip, 0.749 mm (0.0295 inch);0.0295 inch; other metal accessories, 0.909 mm (0.0358 inch);0.0358 inch; unless otherwise indicated. Accessories shall include but not be limited to saddles, welding washers, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

PART 3 EXECUTION

3.1 ERECTION

Erection of deck and accessories shall be in accordance with [SDI Pub No 29] [SDI Diaphram Mnl] and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles

to supports before being permanently secured in place. The deck shall not be [filled with concrete,] used for storage or as a working platform until the units have been secured in position. [Shoring shall be in position before concrete placement begins in composite or form deck.] Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck.
[Acoustical material shall be neatly fitted into the rib voids.]

3.2 SHORING

Shoring requirements for placing and curing of concrete in the composite floor [and roof] deck assemblies shall be as shown.

3.3 ATTACHMENTS

All fasteners shall be installed in accordance with the manufacturer's recommended procedure, except as otherwise specified. The deck units shall be welded with nominal 16 mm 5/8 inch diameter puddle welds [or fastened with screws, powder-actuated fasteners or pneumatically driven fasteners] to supports as indicated on the design drawings and in accordance with requirements of SDI Pub No 29. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. Welding washers [shall] [shall not] be used at the connections of the deck to supports. Welding washers shall not be used at sidelaps. Holes and similar defects will not be acceptable. Deck ends shall be [lapped 50 mm 2 inches] [butted]. All partial or segments of deck units shall be attached to structural supports in accordance with Section 2.5 of SDI Diaphram Mnl. [Powder-actuated fasteners shall be driven with a low-velocity piston tool by an operator authorized by the manufacturer of the piston tool. Pneumatically driven fasteners shall be driven with a low-velocity fastening tool and shall comply with the manufacturer's recommendations.] [Shear connectors shall be attached as shown and shall be welded as per AWS D1.1 [through the steel deck to the steel member] [directly to the steel member].]

3.4 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 150 mm 6 inches across require no reinforcement. Holes and openings 150 to 300 mm 6 to 12 inches across shall be reinforced by 1.204 mm (0.0474 inch) 0.0474 inch thick steel sheet at least 300 mm 12 inches wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 150 mm 6 inches on center. Holes and openings larger than 300 mm 12 inches shall be reinforced by steel angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles perpendicular to the steel

joists. Openings must not interfere with seismic members such as chords and drag struts.

3.5 PREPARATION OF FIRE-PROOFED SURFACES

Deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, shall be galvanized and shall be free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Any required cleaning shall be done prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

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SECTION 05500

MISCELLANEOUS METAL

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 in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

AMERICAN WELDING SOCIETY (AWS)

COMMERCIAL ITEM DESCRIPTIONS (CID)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Miscellaneous Metal Items; [_____], [_____].

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: [_____]

SD-04 Samples

Miscellaneous Metal Items; [_____], [_____].

Samples of the following items: [_____]. Samples shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M, ASTM A 653/A 653M, or ASTM A 924/A 924M, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.7 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have [standard mill

finish.] [hand sanded or machine finish to a 240 grit.] [anodized finish.]

The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish. [Aluminum surfaces to be in contact with plaster or concrete during construction shall be protected with a field coat conforming to CID A-A-344.]

1.8 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS

Doors and panels shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 1.52 mm (16 gauge) 16 gauge steel with welded joints and finished with anchorage for securing into construction. Access doors shall be a minimum of 350 by 500 mm 14 by

20 inches and of not lighter than 1.9 mm (14 gauge) 14 gauge steel, with stiffened edges, complete with attachments. Access doors shall be hinged to frame and provided with a flush face, screw driver operated latch. Exposed metal surfaces shall have a [baked enamel finish] [shop applied prime coat].

2.2 CHIMNEYS, VENTS, AND SMOKESTACKS

Chimneys and vents shall be designed and constructed in accordance with NFPA 211. Chimney connectors shall be formed of not lighter than 1.01 mm (20 gauge) 20 gauge galvanized steel. Stacks shall be designed and constructed to withstand a wind velocity of [_____] km/h mile/h in accordance with ASCE 7. Unlined stacks shall be constructed of black-steel plates not less than 5 mm 3/16 inchthick conforming to ASTM A 36/A 36M. Seams and joints shall be welded, except that an angle flange shall be provided for connection to the boiler, other equipment, and stack support.

2.3 CLEANOUT DOORS

Cleanout doors shall be [galvanized] [cast iron], shall be provided with frames, and unless otherwise indicated, shall be sized to match flues. The frames shall have a continuous flange and anchors for securing into masonry. The doors shall be smokeproof, hinged, and shall have fastening devices to hold the door closed.

2.4 COAL-HOPPER DOORS

Coal-hopper doors shall be constructed of [galvanized] [_____] steel plates and shapes and shall be complete with frame, stops, wall box, hinges, and hasp or locktype latch. Joints and attachments shall be welded.

2.5 CORNER GUARDS AND SHIELDS

Corner guards and shields for jambs and sills of openings and edges of platforms shall be steel shapes and plates anchored in masonry or concrete with welded steel straps or end weld stud anchors. Corner guards for use with glazed or ceramic tile finish on walls shall be formed of 1.6 mm 0.0625 inch thick corrosion-resisting steel with polished or satin finish, shall extend 1.5 m 5 feet above the top of cove base or to the top of the wainscot, whichever is less, and shall be securely anchored to the supporting wall. Corner guards on exterior shall be [galvanized] [_____].

2.6 DOOR GUARDS

Door guards shall be constructed of woven steel wire or expanded metal framed with structural steel shapes. Expanded metal guards shall be of 38 mm 1-1/2 inch No. 10 mesh, welded to 25 by 25 by 3 mm 1 by 1 by 1/8 inch angle frame. Woven-wire panel shall be of 10 gauge, 38 mm 1-1/2 inch mesh secured through weaving to 25 mm 1 inchchannel frame or around a 10 m3/8 inch round bar frame. Corners of frames shall be mitered and welded. Guards shall be sized as indicated.

2.7 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53, Type E or S, weight STD, black finish.

2.8 DOWNSPOUT BOOTS

Downspout boots shall be cast iron with receiving bells sized to fit downspouts.

2.9 EXPANSION JOINT COVERS

Expansion joint covers shall be constructed of extruded aluminum with anodized satin finish for walls and ceilings and with standard mill finish for floor covers and exterior covers. Plates, backup angles, expansion filler strip and anchors shall be designed as indicated. Expansion joint system shall provide a [_____] hour fire rating and [_____] mm inchmovement.

2.10 FIRE ESCAPES

Fire escapes shall be fabricated of steel shapes, shall have treads, platforms and railings as specified for steel stairs, and shall be complete with required fastenings and accessories. Fire escapes and accessories shall be [galvanized] [_____].

2.11 FLOOR GRATINGS AND FRAMES

[Carbon steel] [Aluminum] [Stainless steel] grating shall be designed in accordance with [NAAMM MBG 531] [NAAMM MBG 532] to meet the indicated load requirements. Edges shall be banded with bars 6 mm 1/4 inch less in height than bearing bars for grating sizes above 19 mm.3/4 inch. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to match the grating. Floor gratings and frames shall be [galvanized after fabrication] [_____].

2.12 FLOOR PLATES

Floor plates shall be 6 mm 1/4 inch thick, [raised thread steel.] [pattern indicated.] [galvanized.] [slip-resistant, carbon steel conforming to ASTM A 283/A 283M having a minimum static coefficient of friction of 0.50 when tested in accordance with ASTM D 2047. Wearing surface shall be aluminum oxide or silicon carbide.]

2.13 FOUNDATION VENTS

Foundation vents shall be the same size as the masonry units or sized as indicated, and shall be of extruded aluminum with integral water stop and sliding interior closer or damper operable from the outside. Insect screen shall be provided at the back of the vent. Louvered opening shall have top and bottom drip lips, and the net ventilating area with closer or damper open shall be at least 35 percent of the gross wall opening. The frames shall have a structural strength adequate to permit use in masonry walls without a lintel.

2.14 HANDRAILS

Handrails shall be designed to resist a concentrated load of 890 N (200 pounds) 200 pounds in any direction at any point of the top of the rail or 292 Newtons per meter (20 pounds per foot) 20 pounds per foot applied horizontally to top of the rail, whichever is more severe.

2.14.1 Steel Handrails, Including Carbon Steel Inserts

Steel handrails, including inserts in concrete, shall be [steel pipe conforming to ASTM A 53] [or] [structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength]. Steel railings shall be [40] [50] mm [1-1/2] [2] inch nominal size. Railings shall be [hot-dip galvanized] [and] [shop painted]. Pipe collars shall be [steel.] [hot-dip galvanized steel.] [stainless steel.]

a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

   (1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 10 mm 3/8 inch hexagonal recessed-head setscrews.

   (2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 150 mm 6 inches long.

   (3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

b. Removable sections, toe-boards, and brackets shall be provided as indicated.

2.14.2 Aluminum Handrails

Handrails shall consist of [[40] [50] mm [1-1/2] [2] inch nominal Schedule 40 pipe ASTM B 429] [44 mm 1-3/4 inch square aluminum semi-hollow tube with rounded corners ASTM B 221M ASTM B 221]. Railings and pipe collars shall be [mill finish] [anodized] [aluminum [_____] color]. All fasteners shall be Series 300 stainless steel.

a. Jointing shall be by one of the following methods:

   (1) Flush type rail fittings, welded and ground smooth with splice locks secured with 10 mm 3/8 inch recessed head setscrews.

   (2) Mitered and welded joints, made by fitting post to top rail and intermediate rail to post and corners, shall be groove welded and ground smooth. Splices, where allowed by the Contracting Officer, shall be butted and reinforced by a tight fitting dowel or sleeve not less than 150 mm 6 inches in length. Dowel or

sleeve shall be connected to one side of the splice by tack welding or by using epoxy cement.

(3) Railings shall be assembled using slip-on aluminum-magnesium alloy fittings for joints. Fittings shall be fastened to pipe or tube with 6 mm 1/4 inch or 10 mm 3/8 inch stainless steel recessed head setscrews. Assembled railings shall be provided with fittings only at vertical supports or at rail terminations attached to walls. Expansion joints shall be at the midpoint of panels. A setscrew shall be provided in only one side of the slip-on sleeve. Alloy fittings shall conform to ASTM B 26/B 26M.

b. Removable sections, toe-boards and brackets shall be provided where indicated, using flange castings as appropriate.

2.15 GUY CABLES

Guy cables shall be prestretched, galvanized wire rope of the sizes indicated. Wire rope shall conform to ASTM A 475, high strength grade with Class A coating. Guys shall have a factory attached clevis top-end fitting; guys shall have a factory attached open-bridge strand socket bottom-end fitting; guys shall be complete with oval eye, threaded anchor rods. Fittings and accessories shall be hot-dip galvanized.

2.16 LADDERS

Ladders shall be [galvanized] [_____] steel or aluminum, fixed rail type in accordance with ANSI A14.3.

2.17 METAL GRID WALKWAYS

Metal grid walkways shall be designed to protect rooftops from pedestrian traffic and shall be [2.0 mm (14 gauge)14 gauge minimum galvanized steel] [2.0 mm (12 gauge) 12 gauge minimum aluminum]. The walkway shall consist of metal planks, 610 by 3050 or 3650 mm, 2 by 10 or 12 feet, bolted or welded to support stands. Other sizes may be furnished if approved. In addition to end supports, a midspan support shall be provided when required to limit deflection. End supports shall be located to avoid uplift and to provide continuous runs.

2.18 MIRROR FRAMES

Frames for plate glass mirrors larger than 450 by 750 mm 18 by 30 inches shall be fabricated from [extruded aluminum with anodized finish.] [corrosion-resisting steel with satin finish.] Frames shall be provided with concealed fittings and tamperproof mountings.

2.19 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

2.20 PARTITIONS, DIAMOND MESH TYPE

Partitions shall be constructed of metal fabric attached to structural steel framing members. Fabric shall be [10 gauge steel wires woven into 38 mm 1-1/2 inch diamond mesh with wire secured through weaving channels.] [expanded metal conforming to ASTM F 1267 of 38 mm, 1-1/2 inch, No. 10 diamond mesh secured to channel frame by welding.] [8 gauge steel wires woven into 50 mm 2 inch diamond mesh with wire secured through weaving channels.] Framing members shall be channels 38 by 3 mm 1-1/2 by 1/8 inch minimum size. Channel frames shall be mortised and tenoned at intersections. Steel frames, posts, and intermediate members shall be of the sizes and shapes indicated. Cast-iron floor shoes and caps shall have setscrew adjustment. Doors and grilles shall be provided as indicated, complete with hardware and accessories including sliding mechanisms, locks, guard plates, sill shelves and brackets, and fixed pin butts. Doors and grilles shall have cover plates as indicated. Dutch doors shall have a lock for each leaf. A continuous rubber bumper shall be provided at bottom of grille frame. Locks shall be bronze, cylinder, mortise type. Keying shall be coordinated with Section 08700 BUILDERS' HARDWARE. Ferrous metal portions of partitions and accessories shall be [galvanized] [_____].

2.21 ROLL-UP FLOOR MATS

Roll-up mats shall be of aluminum construction with [carpet] [vinyl] [serrated aluminum] [abrasive] surface. Roll-up mats shall be for use in [level surface area.] [recessed area. Construction details of recessed areas shall be shown on the drawings.]

2.24 ROOF SCUTTLES

Roof scuttles shall be of [aluminum] [galvanized steel not less than 2.0 mm (14 gauge), 14 gauge,] with 75 mm 3 inch beaded flange welded and ground at corners. Scuttle shall be sized to provide minimum clear opening of 940 by 760 mm.37 by 30 inches. Cover and curb shall be insulated with 25 mm 1 inch thick rigid insulation covered and protected by [aluminum sheet] [galvanized steel liner not less than 0.55 mm (26 gauge).26 gauge.] The curb shall be equipped with an integral metal cap flashing of the same gauge and metal as the curb, full welded and ground at corners for weathertightness. Scuttle shall be completely assembled with heavy hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles on [inside] [and] [outside] and neoprene draft seal. Fasteners shall be provided for padlocking on the inside. The cover shall be equipped with an automatic hold-open arm complete with handle to permit one hand release.

2.23 SAFETY CHAINS

Safety chains shall be galvanized welded steel, proof coil chain tested in accordance with ASTM A 467/A 467M, Class CS. Safety chains shall be straight link style, 5 mm 3/16 inch diameter, minimum 39 links per meter (12 links per foot) 12 links per foot and with bolt type snap hooks on each end. Eye bolts for attachment of chains shall be galvanized 10 mm 3/8 inch bolt with 19 mm 3/4 inch eye, anchored as indicated. Two chains shall be furnished for each guarded opening.

2.24 SAFETY NOSING

Safety nosings shall be of [cast iron] [cast aluminum] with [cross-hatched] [plain], abrasive surface. Nosing shall be 75 mm 3 inches wide and terminating at not more than 150 mm 6 inches from the ends of treads, except nosing for metal pan cement-filled treads shall extend the full length of the tread. Safety nosings shall be provided with anchors not less than 19 mm 3/4 inch long. Integrally cast mushroom anchors are not acceptable.

2.25 SHELVING

Shelving shall conform to ANSI MH28.1 and shall be [bolted] [clipped] [open] [closed] and capable of resisting a uniform load of [_____] kg per meter.lbs per foot. Minimum dimensions and number of shelves shall be as indicated.

2.26 STEEL STAIRS

Steel stairs shall be complete with structural or formed channel stringers, [steel plate treads and risers,] [metal pan cement-filled treads,] [grating treads,] [slip-resistant metallic treads,] landings, columns, handrails, and necessary bolts and other fastenings as indicated. Structural steel shall conform to ASTM A 36/A 36M. Stairs and accessories shall be [galvanized] [_____]. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete. Integral nosings shall have braces extended into the concrete fill. Gratings for treads and landings shall conform to NAAMM MBG 531. Grating treads shall have slip-resistant nosings.

2.27 STEEL DOOR FRAMES

Steel door frames built from structural shapes shall be neatly mitered and securely welded at the corners with all welds ground smooth. Jambs shall be provided with 50 by 6 by 300 mm 2 by 1/4 by 12 inch bent, adjustable metal anchors spaced not over 760 mm 2 feet 6 inches on centers. Provision shall be made to stiffen the top member for all spans over 900 mm.3 feet. Continuous door stops shall be made of 38 by 16 mm 1-1/2 by 5/8 inch bars.

2.28 TRENCH COVERS, FRAMES, AND LINERS

Trench covers shall be designed to meet the indicated load requirements. Trench frames and anchors shall be all welded steel construction designed to match cover. Covers shall [be secured to frame] [have flush drop handles formed of 6 mm 1/4 inch round stock], and shall be [raised-tread, or steel floor plate] [cast-iron grating]. Grating opening widths shall not exceed 25 mm.1 inch. Trench liners shall be cast iron with integral frame for cover.

2.29 WHEELGUARDS

Wheelguards shall be hollow, heavy duty, cast iron [half round] [three quarters round], at least 450 mm 18 inches high designed to provide a minimum of 150 mm 6 inches of protection.

2.30 WINDOW GUARDS, BAR GRILLE TYPE

Bar grill window guards shall be of 19 mm 3/4 inch round bars, spaced not over 100 mm 4 inches on centers vertically, and 50 by 13 mm 2 by 1/2 inch horizontal bars spaced not over 300 mm 12 inches on centers. Vertical bars shall be extended through and securely welded to the cross bars. Horizontal bars shall be extended, bent, and drilled as shown for anchorage at jambs of window openings.

2.31 WINDOW GUARDS, DIAMOND MESH TYPE

Diamond mesh window guards shall be constructed of woven steel wire or expanded metal frames with hot-rolled or cold-formed steel shapes. Expanded metal conforming to ASTM F 1267 shall be of 38 mm, 1-1/2 inch, No. 10 mesh, welded to 25 by 25 by 3 mm 1 by 1 by 1/8 inchangle frame. Woven-wire panels shall be of 10 gauge, 38 mm 1-1/2 inch mesh secured through weaving bar to 10 mm 3/8 inch round or 25 mm 1 inch channel frame. Corners of frames shall be mitered and welded or mortised and tenoned. One tamperproof hasp and padlock, with access from the interior, shall be provided for each butt used.

2.32 WINDOW SUB-SILL

Window sub-sill shall be of extruded aluminum alloy of size and design indicated. Not less than two anchors per window section shall be provided for securing into mortar joints of masonry sill course. Sills for banks of windows shall have standard mill finish with a protective coating, prior to shipment, of two coats of a clear, colorless, methacrylate lacquer applied to all surfaces of the sills.

2.33 WINDOW WELLS

Window wells shall be not lighter than 1.5 mm (16 gauge), 16 gauge, corrugated sheet steel, hot-dip galvanized after fabrication. Top edge of walls shall have a 19 mm 3/4 inch bead or rolled top. Window wells shall be semicircular or semielliptical in form and shall overlap the window by at least 75 mm 3 inches on each side. Removable cover, hot-dip galvanized after fabrication, consisting of steel bar grate with bars spaced at not more than 50 mm 2 inch centers and welded to 25 by 6 mm 1 by 1/4 inch frame shall be designed to fit into and rest on top edge of window well.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 REMOVABLE ACCESS PANELS

A removable access panel not less than 300 by 300 mm 12 by 12 inches shall be installed directly below each valve, flow indicator, damper, or air

splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.3 INSTALLATION OF CHIMNEYS, VENTS, AND SMOKESTACKS

Chimneys and vents shall be installed in accordance with NFPA 211. A cleanout opening with a tight-fitting, hinged, cast-iron door and frame shall be provided at the base of each smokestack. A top band shall be provided on stacks for attachment of painter's rigging. Roof housing, rain cap, downdraft diverter, fire damper, and other accessories required for a complete installation shall be provided. Sections of prefabricated lined stacks shall be joined with acid-resisting high-temperature cement and steel draw bands. Means to prevent accumulation of water in the smokestack shall be provided.

3.4 DOOR GUARD FRAME

Door guard frame shall be mounted over the glazed opening using 6 mm 1/4 inch lag bolts on the interior of wood doors or tamperproof through bolts on the interior of metal doors.

3.5 INSTALLATION OF PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete [specified in SECTION 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.] [having a compressive strength of 21 MPa.3000 psi.]

3.6 INSTALLATION OF DOWNSPOUT BOOTS

Downspouts shall be secured to building through integral lips with appropriate fasteners.

3.7 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.7.1 Installation of Steel Handrails

Installation shall be [in pipe sleeves embedded in concrete and filled with molten lead or sulphur with anchorage covered with standard pipe collar pinned to post.] [by means of pipe sleeves secured to [wood with screws.] [masonry with expansion shields and bolts or toggle bolts.] [base plates bolted to stringers or structural steel framework.]] Rail ends shall be secured by steel pipe flanges [anchored by expansion shields and bolts.] [through-bolted to a back plate or by 6 mm 1/4 inch lag bolts to studs or solid backing.]

3.7.2 Installation of Aluminum Handrails

Installation shall be by means of [flanges anchored to concrete or masonry by expansion shields] [base plates or flanges bolted to stringers or structural steel framework] [flanges through-bolted to a back plate or by 6

mm 1/4 inch lag bolts to studs or other structural members]. Bolts used to anchor aluminum alloy flanges shall be stainless steel of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or portland cement concrete, the contact surface shall be given a heavy coating of bituminous paint or asphalt varnish.

3.8 ERECTION OF GUY CABLES

Guy cables shall be erected as indicated. Anchor rods shall be cast in concrete located and reinforced as shown.

3.9 INSTALLATION OF METAL GRID WALKWAYS

Walkways shall be installed after final flood coat and aggregate surfacing. Each stand shall be set on a protective pad; the pad may be adhesively attached to the bottom of the stand or set loose under the stand. The area where the supports are to be located shall be swept clear of loose aggregate. Protective pad shall be placed on the roof membrane except on inverted roofs where the protective pad shall be set on the rigid insulation.

3.10 PARTITION POSTS AND OPENINGS

Posts shall be set in shoes bolted to the floor and in caps tap-screwed to clip angles in overhead construction, as indicated. Openings shall be formed using channels similar to the partition frames at ducts, pipes, and other obstructions.

3.11 RECESSED FLOOR MATS

Contractor shall verify field measurements prior to releasing materials for fabrication by the manufacturer. A mat frame shall be used to ensure recess accuracy in size, shape and depth. Drain pit shall be formed by blocking out concrete when frames are installed. Pit shall be dampproofed after concrete has set. Frames shall be assembled onsite and installed so that upper edge will be level with finished floor surface. A cement base shall be screeded inside the mat recess frame area using the edge provided by the frame as a guide. The frame shall be anchored into the cement with anchor pins a minimum of 610 mm 24 inches on centers.

3.12 MOUNTING OF SAFETY CHAINS

Safety chains shall be mounted 1070 mm 3 feet 6 inches and 610 mm 2 feet above the floor.

3.13 INSTALLATION OF SAFETY NOSINGS

Nosing shall be completely embedded in concrete before the initial set of the concrete occurs and shall finish flush with the top of the concrete surface.

3.14 DOOR FRAMES

Door frames shall be secured to the floor slab by means of angle clips and expansion bolts. Continuous door stops shall be welded to the frame or tap screwed with countersunk screws at no more than 450 mm 18 inchcenters, assuring in either case full contact with the frame. Any necessary reinforcements shall be made and the frames shall be drilled and tapped as required for hardware.

3.15 TRENCH FRAMES AND COVERS

Trench frames and covers shall finish flush with the floor.

3.16 INSTALLATION OF WHEEL GUARDS

Wheel guards shall be filled with concrete and anchored to the floor or the building according to the manufacturer's recommendations.

3.17 BAR-GRILLE WINDOW GUARDS

Bar-grille window guards shall be securely anchored to masonry with 13 mm 1/2 inch diameter prison-type screws or bolts and expansion shields, or other type of fastenings if the ends of such fastenings are welded to the adjoining metal grilles or otherwise made tamperproof in a satisfactory manner. Spanner-head screws or bolts are not considered prison-type fasteners.

3.18 DIAMOND MESH WINDOW GUARDS

Diamond mesh window guards shall be mounted on [interior window frame with not less than two tamperproof hinged butts mounted on wood jambs.] [exterior of window frame with not less than two tamperproof hinged butts mounted on 25 by 300 by 3 mm 1 by 12 by 1/8 inch jamb channel attached as indicated to 50 by 6 mm 2 by 1/4 inch plate anchored to wood jamb with 6 mm 1/4 inch lag bolt, to masonry jamb with toggle bolts, or to concrete jambs and solid masonry jambs with expansion shields and bolts.] One additional butt shall be provided for each 900 mm 3 foot internal length of guard over 1500 mm.5 feet. Hasp and padlock shall be installed on the jamb opposite to that hinged.

3.19 INSTALLATION OF WINDOW WELLS

Window wells shall be placed as shown with the walls securely anchored to foundation surface. The area within the well shall be excavated to the bottom of the well and covered with a 100 mm 4 inch thick layer of coarse gravel or crushed rock.

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SECTION 09200

LATHING AND PLASTERING

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 in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1.2 UBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; [_____], [_____]

Drawings including installation details, ceiling framing, and furring.

SD-03 Product Data

Lathing Installation; [_____], [_____]

Manufacturer's pre-printed descriptive data, catalog cuts, and installation instructions for plastering materials and accessories.

SD-04 Samples

Gypsum Plaster; [_____], [_____]

[One] [_____] 1 m 36 inch square sample panel of each specified finish.

SD-07 Certificates

Qualifications; [_____], [_____]

Manufacturer's experience in specified work.

Gypsum Plaster; [____], [____]

Certification indicating that factory-mixed plaster provides a minimum compressive strength of not less than 6.9 MPa (1000 psi) 1000 psi when tested in accordance with ASTM C 472.

1.3 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified, and shall have a minimum of [5] [_____] years of documented successful experience. Applicator shall specialize in the type of lath and plaster work required to meet requirements, with a minimum of [3] [_____] years of documented experience.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered to project site in the original containers bearing the name of manufacturer, contents, and brand name. Plaster, cement, and lime shall be stored off the ground under weathertight cover and away from sweating walls and other damp surfaces until ready for use. Accessories shall be stored off the ground in a weathertight structure for protection. Damaged or deteriorated materials shall be removed from project site.

1.5 ENVIRONMENTAL CONDITIONS

A temperature between 4 degrees C 40 degrees F and 27 degrees C 80 degrees F shall be evenly maintained in the building for a period of not less than 1 week prior to application of plaster, and for a period of at least 1 week after the gypsum plaster is set, in accordance with ASTM C 842. Interior spaces shall be ventilated in accordance with ASTM C 842 immediately after applying plaster.

PART 2 PRODUCTS

2.1 NON-LOADBEARING WALLS

2.1.1 Studs

Studs for non-loadbearing walls shall conform to ASTM C 645. Studs shall be C-shaped, roll-formed steel with minimum uncoated design thickness of [0.45 mm (0.0179 in)0.0179 in][0.72 mm (0.0284 in) 0.0284 in][0.84 mm (0.0329 in) 0.0329 in] [_____] made from G40 hot-dip galvanized coated sheet.

2.1.2 Runner Tracks

Prefabricated floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be prefabricated, U-shaped, unpunched web, thickness to match studs, made from G40 hot-dip galvanized coated sheet.

2.2 LOADBEARING STUD WALLS

2.2.1 Studs

Studs for loadbearing walls shall conform to ASTM C 955. Studs shall be C-shaped, roll-formed steel made from minimum G60 hot-dip galvanized coated sheet. Stud sizes and base metal design thickness shall be as shown.

2.2.2 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 955. Tracks shall be prefabricated, U-shaped with minimum 19 mm 3/4 inch flanges, unpunched web, made from G60 hot-dip galvanized coated sheet.

2.2.3 Bridging

Bridging in loadbearing walls shall conform to ASTM C 955. Bridging shall be minimum 19 mm 3/4 inch wide x 11 mm 7/16 inch deep cold-rolled steel channel with weld attachment clips at each stud location or V-bar type weld or screw attached to each stud flange. Bridging shall be adequate to provide lateral support for the stud.

2.3 METAL WALL FURRING

Metal wall furring channels shall conform to ASTM C 645. Furring channels shall be formed from cold-rolled steel, 19 mm 3/4 inch wide x 11 mm 7/16 inch deep, made from G40 hot-dip galvanized coated sheet.

2.4 SUSPENDED CEILING FRAMING

Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of L/240. Carrying channels shall be formed from minimum 1.40 mm thick (0.0548 in) 0.0548 in cold-rolled steel, 38 mm 1-1/2 inch wide x 11 mm 7/16 inch deep. Cross furring members shall conform to ASTM C 645, and shall be formed from cold-rolled steel, 19 mm 3/4 inch wide x 11 mm 7/16 inch deep. Carrying channels and furring members shall be made from hot-dip galvanized coated sheet.

2.5 TRIM, MOLDINGS, AND ACCESSORIES

2.5.1 Hangers

Suspended ceiling runner channel hangers shall be [soft, annealed steel wire not less than No. 8 SWG nominal diameter, conforming to ASTM A 853] [or] [flat iron or steel straps, at least 2 x 22 mm 3/32 x 7/8 inch size, coated with zinc, cadmium, or rust-inhibiting paint].

2.5.2 Fastenings

Tie wire, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A 580/A 580M, composition 302, 304, or 316, Condition A, or nickel-copper alloy conforming to ASTM B 164, annealed condition. Walls, partitions, and other vertical surfaces not incorporated in ceiling construction may be erected with soft, annealed steel conforming to ASTM A 853.

2.5.2.1 Tie Wire

Tie wire for constructing partitions and vertical furring, for securing metal lath to supports, and for lacing shall be not less than No. 18 SWG diameter. Tie wire for all other applications shall be not less than No. 16 SWG diameter.

2.5.2.2 Clips

Clips used in lieu of tie wire for securing furring channels to the runner channels in ceiling construction shall be made from strips not less than 3 mm 1/8 inch thick or shall be hairpin clip formed of No. 8 SWG wire. Other clips and rings or fastenings of similar materials shall be equivalent in holding power to that provided by tie wire for the specific application.

2.5.3 Arch, Flexible Corner Beads

Flexible corner beads shall be fabricated of [aluminum][vinyl] [0.50 mm thick (0.0210 in) 0.0210 in galvanized steel] 0.76 mm (0.030 inch) [for][0.030 inch thick zinc alloy], with minimum 32 mm 1-1/4 inch wide flanges and 3 mm 1/8 inch thick bead, designed to bend without buckles, kinks, or breaks in the nose.

2.5.4 Expanded Flange Corner Beads

Expanded flange corner beads shall be fabricated of [vinyl] [or] [aluminum][0.50 mm thick (0.0210 in) 0.0210 in galvanized steel][0.76 mm (0.030 inch) 0.030 inch thick zinc alloy], with 64 mm 2-1/2 inch wide flanges and 3 mm 1/8 inch wide bead.

2.5.5 Bullnose Corner Beads

Bullnose corner beads shall be fabricated of [vinyl] [or] [aluminum][0.50 mm thick (0.0210 in) 0.0210 in galvanized steel], with 64 mm 2-1/2 inch wide flanges and 20 mm 3/4 inch bead.

2.5.6 Cornerites

Cornerites shall conform to ASTM C 847. Cornerites shall be fabricated of galvanized expanded metal lath to form an angle of at least 100 degrees, with outstanding legs of not less than 50 mm 2 inches.

2.5.7 Striplath

Striplath shall conform to ASTM C 847. Striplath shall be fabricated of galvanized steel sheet, 1.4 kg per square meter. 2.5 pounds per square yard.

2.5.8 Base or Parting Screed

Base screeds shall be fabricated of 0.50 mm thick (0.0210 in) 0.0210 in galvanized steel, 13 mm 1/2 inch depth, with not less than 50 mm 2 inch wide expansion flanges.

2.5.9 Casing Beads

Casing beads shall be fabricated of [vinyl] [galvanized 0.70 mm (0.0276 inch) 0.0276 inch thick steel] [13][19] mm [1/2][3/4] inch depth, [25][50] mm [1][2] inch wide expansion wings, front edge of face flange shaved for intended use, back slightly arched to provide a spring effect.

2.5.10 Control Joints

Control joints shall be designed for expansion and contraction of plaster work due to thermal exposure. Control joints shall be fabricated of [vinyl][0.55 mm (0.0217 inch) 0.0217 inch thick galvanized steel for interior applications][or][0.76 mm (0.030 inch) 0.030 inch thick zinc alloy for exterior applications], with perforated or expanded-metal wings.

2.5.11 Reveal Molding

Reveal moldings shall be fabricated of [aluminum] [vinyl] [galvanized steel] [or] [zinc]. reveal molding shall be size and shape as shown.

2.5.12 Raidused Column Trim

Raidused column moldings shall be fabricated of aluminum and shall be shape and sizes as shown.

2.5.13 Screws

Self-drill steel screws shall conform to ASTM C 1002. Screws shall be [Type S for use with steel framing] [and] [Type W for use with wood members].

2.6 METAL LATH

2.6.1 Expanded Metal Lath

Expanded metal lath shall conform to ASTM C 847. Lath shall be [flat base lath] [self-furring lath] [flat rib lath] [rib lath], expanded from cold-rolled carbon sheet steel of commercial quality, coated with rust-inhibitive paint after fabrication, 1.8 kg per square meter 3.4 pounds per square yard, [with backing] [without backing].

2.6.2 Welded Wire Lath

Welded wire lath shall conform to ASTM C 933. Lath shall be [flat base] [self-furring] type, fabricated from not less than 1.6 mm (0.0625 inch) 0.0625 inch copper-bearing, cold-drawn, galvanized steel wire, [with backing] [without backing].

2.6.3 Woven Wire Lath

Woven wire lath shall conform to ASTM C 1032. Lath shall be [flat base] [self-furring] type [with stiffeners] [without stiffeners], [with backing] [without backing] fabricated from copper-bearing, cold-drawn, galvanized steel wire not less than 1.40 mm (0.0548 in) 0.0548 in, thick with openings not to exceed 50 x 50 mm 2 x 2 inch welded.

2.7 GYPSUM LATH AND VENEER PLASTER BASE

2.7.1 Gypsum Lath

Gypsum lath shall conform to ASTM C 37. Lath shall be [plain] [aluminum foil backed] [Type X] [lead-backed for control of X-ray transmission] designed to be used as a base for gypsum plaster.

2.7.2 Veneer Plaster Base

Veneer plaster base shall conform to ASTM C 588. Base shall be [aluminum foil backed] [Type X], and shall be designed to be used as a base for gypsum veneer plaster.

2.8 GYPSUM PLASTER

2.8.1 Ready-Mixed Gypsum Plaster

[Ready-mixed plaster for use over gypsum or metal lath shall conform to ASTM C 28 for the following: ready-mixed plaster with vermiculite aggregate; ready-mixed plaster with perlite aggregates; ready-mixed plaster with sand aggregate.] [Ready-mixed gypsum plaster for use over masonry bases shall conform to ASTM C 28 for plaster with vermiculite aggregate.] [Ready-mixed plaster for use over veneer plaster bases shall conform to ASTM C 587.]

2.8.2 Gypsum Neat Plaster

Gypsum neat plaster shall conform to ASTM C 28.

2.8.3 Gypsum Wood-Fibered Plaster

Gypsum wood-fibered plaster shall conform to ASTM C 28.

2.8.4 Gypsum Gauging Plaster for Finish Coats

Gypsum gauging plaster shall conform to ASTM C 28. Keene's quick-set cement for finish coats shall conform to ASTM C 61.

2.9 CEMENT PLASTER MATERIALS

2.9.1 Portland Cement

Portland cement shall conform to ASTM C 150, [gray portland cement Type [I], [II], [III]] [white portland cement Type [I] [II]] with 13 mm1/2 inch chopped alkali-resistant fiberglass strands or polypropylene fibers, minimum 680 g 1-1/2 pounds per sack of cement.

2.9.2 Aggregates

The unit weight of aggregates shall be determined in accordance with ASTM C 29/C 29M. Gypsum aggregates shall conform to ASTM C 35. Portland cement based plaster aggregates shall conform to ASTM C 897, except that the gradation of natural or manufactured sand for portland-cement plaster shall be as follows:

Sieve Size	Sand, Percentage by Weight Retained on Each Sieve	
	Maximum (mm)	Minimum
	4.75	0 --
	2.36	8 2
	1.18	38 22
	0.60	78 52

Sieve Size	Sand, Percentage by Weight Retained on Each Sieve	
	Maximum (mm)	Minimum
	0.30	97 65
	0.15	100 97

Sieve Size	Sand, Percentage by Weight Retained on Each Sieve	
	Maximum (inches)	Minimum
	4	0 --
	8	8 2
	16	38 22
	30	78 52
	50	97 65
100	100	97

2.9.3 Water

Water shall be clean, fresh, potable, and free from injurious amounts of oils, acids, alkalis and organic matter injurious to the plaster and to any metal in the system.

2.9.4 Lime

Lime shall conform to ASTM C 206, [Type N-Normal hydrated finishing lime] [Type S-Special hydrated finishing lime] suitable for use in scratch brown and finish coats of portland-cement plaster.

2.10 WALL OPENING FRAMES

Steel frames for wall openings for doors, pass-through openings, and access panels shall be as specified in Section 08110 STEEL DOORS AND FRAMES or Section 05500 MISCELLANEOUS METAL. Wood frames, wood bucks, and blocking for wall openings for doors, pass-through openings, and access panels shall be as specified in Section 06100 ROUGH CARPENTRY.

PART 3 EXECUTION

3.1 PREPARATION

Project conditions shall be verified as ready to receive the work. Field measurements shall be verified for compliance with approved detail drawings and manufacturer's published recommendations. Beginning of installation means installer accepts existing conditions.

3.2 SUSPENDED CEILING FRAMING INSTALLATION

Suspended system shall be installed in accordance with ASTM C 841. Where channels are spliced, the ends shall be overlapped not less than 300 mm 12 inches for 38 mm 1-1/2 inch channels and not less than 200 mm 8 inches for 20 mm 3/4 inch channels with flanges of channels interlocked and securely tied near each end of the splice with two loops of the tie wire. Splices shall be staggered.

3.2.1 Hangers

Wire or strap hangers shall be attached to structural members in accordance with ASTM C 841, except hangers shall be spaced not more than 1220 mm 48 inches along runner channels and 900 mm 36 inches in the other direction or 1050 mm 42 inches in both directions unless otherwise indicated or approved. Locations of hangers shall be coordinated with other work.
Hangers at ends of runner channels shall be located not more than 150 mm 6 inches from wall. Hanger wire shall be looped around bottom chord of open-web steel joist or secured to structural elements with suitable fasteners. Sags or twists in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced.

3.2.2 Main Runners

Main runner channels shall be installed in accordance with ASTM C 841. Hanger wire shall be saddle-tied to runner channels, and the end of hanger wires shall be twisted three times around itself. Main runners shall not come in contact with abutting masonry or concrete walls and partitions. Main runners shall be located within 150 mm 6 inches of the paralleling wall to support the ends of cross furring.

3.2.3 Furring Channels

Furring channels shall be spaced in accordance with ASTM C 841 for the type of lath used. Furring channels shall be securely saddle-tied to the runner channels and to structural supports at each crossing with tie wire, hairpin clips, or equivalent clips or fastenings. Furring channels shall be located within 50 mm 2 inches of parallel walls and beams, and 15 mm 1/2 inch from abutting walls. When gypsum lath is used on ceilings, hat-shaped sheetmetal

furring channels may be used in lieu of 19 mm 3/4 inch rolled steel furring channels. Gypsum lath shall be screw-applied at 200 mm 8 inches on centers along supports and not less than 10 mm 3/8 inch from edges of lath.

3.2.4 Light Fixtures and Air Diffusers

Light fixtures and air diffusers shall be supported directly from suspended ceiling runners. Wires shall be provided at appropriate locations to carry the weight of recessed or surface mounted light fixtures and air diffusers.

3.3 FURRED CEILING FRAMING INSTALLATION

Ceiling runners at continuous furred ceilings shall be applied directly to furring channels and secured thereto with tie wire, bolts, or screws at not more than 600 mm 24 inch centers.

3.4 WALL FRAMING INSTALLATION

3.4.1 Loadbearing Wall Framing

Load-bearing steel studs shall be spaced for the type of lath used at external corners, partition ends, and approximately 50 mm 2 inches each side of internal corners. Floor and ceiling runners shall be firmly secured to structural members with screws or bolts in expansion shields, hard-tempered stub nails, powder-actuated anchors, or by other approved methods at not more than 600 mm 24 inch centers. Studs shall be attached to runner tracks with rivets or screws. Runner to tracks shall be aligned to partition layout at floor and ceiling, and shall be secured to concrete slabs with minimum 22 mm 7/8 inch powder-driven pins or 19 mm 3/4 inch concrete stub nails at no more than 1200 mm 48 inches on centers. Each stud shall be aligned, plumb and true to top and bottom runner tracks.

3.4.2 Non-Loadbearing Wall Framing

Nonload-bearing steel studs shall be installed in accordance with ASTM C 754 with spacings as indicated in ASTM C 841 for the type of lath used. Studs shall be aligned and secure in top and bottom runners at spacings indicated on drawings. [One] [Two] beads of acoustic sealant shall be placed between runners and substrate to achieve the required air seal. Stud splicing is not acceptable. Corners shall be constructed with a minimum of three studs. Stud framing system shall be braced and made rigid.

3.4.3 Adjoining Walls and Columns

Studs which adjoin walls or columns shall be secured near the top and bottom, and at least one intermediate point, but not more than 1.5 m5 feet on centers, with wire inserts, dovetail anchors, toggle bolts, or bolts set in expansion shields.

3.4.4 Wall Bracing

Partitions more than 3 m 10 feet long or 2.7 m 9 feet high shall be braced with 19 mm 3/4 inch steel channel stiffeners concealed horizontally. Stiffeners shall be spaced vertically not more than 2 m 6 feet and shall be

secured to each stud. Unsupported partitions 6 m 20 feet or more in height shall be braced with 40 mm 1-1/2 inch channel type horizontal stiffeners.

3.4.5 Corners and Intersection

Corners and intersections of partitions shall be formed of three studs. Studs at internal corners shall be placed not more than 50 mm 2 inches from partition intersection.

3.4.6 Wall Openings

One loadbearing metal stud shall be installed at each jamb of door openings continuous from floor to ceiling, and shall be welded to jamb anchors and runner tracks. Jack studs shall be attached to runner track on interior of head of frame, and to runner track or 19 mm 3/4 inch channel at ceiling. A 19 mm 3/4 inch channel reinforcement shall be placed inside the partition 150 to 200 mm 6 to 8 inches above door openings continuously through two stud spaces on each side of jambs, and welded to the flange. Studs shall be doubled at wall openings, with not more than 50 mm 2 inches each side of openings. Stud placement shall be coordinated with supports and attachments. Intermediate studs above and below openings shall be secured at same spacing as wall studs. Stud framing shall extend to ceiling or through ceiling as indicated on drawings. Clearance shall be maintained between partition and structure to avoid deflection transfer to studs of partitions which extend through ceiling to structure. Placement of insulation in stud spaces shall be made inaccessible after studs are installed.

3.4.7 Bucks, Anchors and Blocking

Installation of bucks, anchors, and blocking shall be coordinated with electrical and mechanical work to be placed in or behind stud framing, and shall be coordinated with blocking requirements for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware and similar items scheduled for installation.

3.5 WALL FURRING INSTALLATION

Metal furring shall be installed in accordance with ASTM C 754 and ASTM C 841.

3.6 SINGLE/DOUBLE CHANNEL, AND STUDLESS SOLID PARTITION INSTALLATION

Channel studs for single channel and double channel stud partitions shall be spaced 400 mm 16 inches on centers and shall be secured to ceiling runners and to floor runners or base clips with wire ties or sheet-metal screws. Studs on each side of door openings shall be doubled and stiffened with a 6 x 25 mm 1/4 x l inch flat steel strut, shop-coated with rust-inhibiting paint. Ends of struts shall be bent and punched for bolting to floor and ceiling construction. Where rib metal lath is the plaster base in continuous lengths from ceiling runners to floor runners for partitions less than 3 m 10 feet in height, steel channel studs may be excluded from the partition except at locations previously specified for door openings. Rib

lath shall be firmly attached to ceiling runner tracks or cornerite and to floor runner track or base by wire ties located not more than 200 mm 8 inches on centers. Studless rib lath partitions shall be limited to not less than 50 mm2 inches thick. Partitions shall be as shown.

3.7 LATHING INSTALLATION

3.7.1 Metal Lath on Vertical Surfaces

Metal lath shall be applied with the long dimension across the supports, with true even surfaces, and without sags or buckles in accordance with ASTM C 841. Metal lath on vertical surfaces shall be oriented to provide maximum mechanical bond with plaster and the upper sheet shall be attached to overlap the lower sheet. When paper-backed lath is used, the upper sheet shall be attached to overlap the lower sheet. The lath shall be secured to supports at intervals not exceeding 150 mm. 6 inches. Nails or staples shall be used for securing lath to wood supports. Tie wires, rings, clips, or other approved fasteners having equivalent holding power of the tie wires shall be used for securing the plaster base to metal supports and to concrete or masonry. Side-laps or junction of sides of plaster base shall be tied or otherwise secured at intervals not exceeding 225 mm 9 inches between supports, in addition to being secured to supports.

3.7.2 Metal Lath on Ceilings

Metal lath on ceilings shall be in accordance with ASTM C 841. [Lath on unrestrained ceilings shall not be turned down at junction with wall or tied to wall lath or furring.] [Lath on restrained ceilings shall be turned down at junction with wall, or shall be applied to cornerite or corner bead.]

3.7.3 Side and End Laps

Side and end laps of metal plaster bases shall be performed in accordance with ASTM C 841 for flat lath and ribbed lath.

3.7.4 Chases and Recesses

Chases and recesses shall be lathed for plastering. Openings over 300 mm 12 inches wide shall be bridged with furring channels spaced 300 mm 12 inches on centers. Openings 300 mm 12 inches wide and less do not need to be bridged. Lath shall extend 75 mm 3 inches beyond the edges of opening. Lath shall be securely fastened by nailing or tying. Lath shall be securely fastened with nails, screws or wire ties.

3.7.5 Installation of Gypsum Lath

Gypsum lath shall be installed in accordance with ASTM C 841. Spring clips or floating-wall-type attachment may be used in lieu of nails. Lath shall be cut and fitted to allow slight clearance around openings. Horizontal or vertical joints are not acceptable at corners of openings. End joints shall be made over supports. Where clip systems are approved, end joints shall be staggered in alternate courses. End joints shall not coincide with ceiling joints, and shall not occur in the same course on opposite side of support.

Internal corners shall be reinforced with cornerites, and external corners shall be reinforced with corner beads. Internal corners of unrestrained ceilings shall not be reinforced with cornerites.

3.8 INSTALLATION OF GYPSUM BASE TO RECEIVE VENEER PLASTER

Gypsum base shall be installed in accordance with ASTM C 844. Base shall be cut and fitted to allow slight clearance around openings. Horizontal or vertical joints are not acceptable at corners of openings. End joints shall be made over supports. Where clip systems are approved, end joints shall be staggered in alternate courses. End joints shall not coincide with ceiling joints, and shall not occur in the same course on opposite side of support. Internal corners shall be reinforced with cornerites, and external corners shall be reinforced with corner beads. Internal corners of unrestrained ceilings shall not be reinforced with cornerites.

3.9 OPENINGS

Reinforcement shall be provided at corners of openings in plastered areas extending 300 mm 12 inches or more in any dimension by securing striplath diagonally at corners. Striplath shall be at least 150 mm6 inches wide by 400 mm 16 inches long. Shorter lengths shall be used to preclude lapping striplath. Striplath shall be secured to lathing without extending fastenings into or around supporting members. Where plaster is applied directly to concrete or masonry surfaces, striplath shall be secured to the concrete or masonry.

3.9.1 Steel Frames

Steel frames shall be securely attached through built-in anchors to the nearest stud on each side of opening with tie wire, bolts, screws, or welding or bracing where bracing is specified. Steel frames shall be grouted solid with plaster grout and a groove shall be formed within the frame returns to receive lath and plaster.

3.9.2 Wood Frames

Wood frames shall be securely attached to the nearest stud in frame partitions and to wood bucks built into the solid partition. Sizes shall be as indicated for each type and size of wall or partition.

3.9.3 Ceiling Openings

Framing shall be provided for ceiling openings and supplemental supporting members for items mounted in ceiling or attached to ceiling suspension system. Frames for openings shall be secured to lath support members. Frames provided with expanded metal flanges shall be secured to lath. Intermediate structural members shall be provided for attachment or suspension of support members.

3.9.4 Openings in Hollow Partitions

Hollow partition door openings shall be additionally braced by tying together each set of double-jamb studs with not less than four solid metal column clips evenly spaced along each jamb.

3.9.5 Openings in Partitions Not To Structure

Partitions not extending to the structural ceiling or structural supports or frame shall be strengthened at openings with angle bracing from each jamb location anchored to the structural ceiling or supports.

3.9.6 Cross Bracing

Cross bracing between partitions or similar bracing may be substituted for angle bracing as approved. Minor frames such as those required for access panels may be provided with expanded metal flanges which shall be attached to lath.

3.10 INSTALLATION OF TRIM, MOLDINGS, AND ACCESSORIES

Trim, moldings, and accessories shall be installed in standard lengths level and plumb to straight lines and as indicated on drawings. Fastenings shall be spaced not over 300 mm 12 inches on centers for single-flanged accessories and not over 600 mm 24 inches on centers on each flange of double-flanged accessories. Items shall be mitered or coped at corners, or prefabricated corners shall be used. Joints in straight runs shall be formed with splice or tie plates.

3.10.1 Base Screeds

Base screeds shall be installed approximately 75 mm 3 inches above finished floor elevation unless indicated otherwise.

3.10.2 Corner Beads

Corner beads shall be installed in standard lengths at external plastered corners, and shall be secured to furring members or supports.

3.10.3 Cornerites

Cornerites shall be installed at internal angles formed by abutting surfaces of gypsum lath or metal lath not turned down at horizontal corners or returned around vertical corners. Cornerites shall be secured to lathed surfaces. Cornerites shall be secured to concrete or masonry where plaster is applied directly to concrete or masonry surfaces. Cornerites shall not be installed at unrestrained ceilings.

3.10.4 Casing Beads

Casing beads shall be installed at the joints of dissimilar base materials in the same plane and at exposed edges of plaster including junctions of walls and ceilings except that beads shall not be installed at restrained ceilings abutting plastered surfaces. At the perimeter of unrestrained suspended ceilings, the casing bead shall be secured to the ceiling to provide a 10 mm 3/8 inch opening between the abutting surfaces. The opening

shall be sealed prior to plastering with sealant as specified in Section 07900 JOINT SEALING.

3.10.5 Expansion and Control Joint Beads

Expansion joint beads shall be installed as control joints in plasterwork at the locations indicated. Plaster base shall not be run continuous through control joints. Additional supports shall be installed as required to support the beads.

3.10.6 Trim

Trim shall be installed where indicated and as required to complete the plaster work.

3.11 PLASTER THICKNESS AND SURFACE EVENNESS

Plaster thickness and surface evenness shall be controlled by grounds or screeds of metal, wood, or plaster. Wood grounds are specified under Section 06100 ROUGH CARPENTRY. Plaster thickness shall be as shown.

3.11.1 Grounds and Screeds

Grounds shall be used for securing trim items, and for finished corners and terminations. Screeds shall be installed for base screeds when wood or metal grounds are not required. Temporary screeds shall be installed when permanent screeds or grounds cannot be used. On completion of approved base coats, temporary screeds shall be removed and voids immediately filled with plaster.

3.11.2 Plaster Screeds

Plaster screeds shall be used within the plastered areas to supplement wood and metal grounds and screeds.

3.12 PLASTER GROUT

Plaster grout shall be scratch-coat material mixed to a non-fluid consistency. Plaster grout shall be used to fill steel door frames and partition bases. Grout shall be placed and grooved prior to gypsum lathing operations. Heads and jambs of frames shall be filled solid with grout, and 13 mm 1/2 inch deep grooves shall be formed in the grout, while plastic, to receive gypsum lath.

3.13 PROPORTIONS AND MIXING

3.13.1 Portland Cement Plaster Base Coat

Base coat shall be proportioned and mixed in accordance with ASTM C 926 coat [L] [C].

3.13.2 Lime-Putty Finish

Lime-putty finish shall be mixed in the proportion of 1 part of gypsum gauging plaster, calcined gypsum, to 3 parts of lime putty by volume. The

mix shall be approximately equivalent to one 45 kg 100 pound bag of gypsum plaster to four 23 kg 50 pound bags of hydrated lime or 0.13 cubic meters 4.5 cubic feet of lime putty or 0.13 cubic meters 35 gallons of lime putty. Perlite or vermiculite aggregated base coats shall have 23 kg 50 pounds of fine white sand or 0.014 cubic meters 1/2 cubic foot of perlite fines added for each 45 kg100 pounds of gauging plaster.

3.13.3 Prepared-Gypsum Finish

Prepared-gypsum finish shall be mixed with water to the proper consistency in accordance with manufacturer's published instructions. Prepared-gypsum finish shall have a minimum compressive strength of not less than 2 MPa300 psi when tested in accordance with ASTM C 472. Prepared gypsum finish shall be used only over sanded base coats.

3.13.4 Keene's Cement Finish

Keene's cement finish shall be mixed in the proportions of 45 kg 100 pounds of Keene's cement to 11 kg, 25 pounds, dry weight, of hydrated lime. The mix shall be approximately equivalent to one 45 kg100 pound bag of Keene's cement to one-half 23 kg 50 pound bag of hydrated lime or 23 kg 50 pounds lime putty or 0.017 cubic meters 4-1/2 gallons lime putty. Subject to approval, 5 kg 10 pounds of fine white sand may be added to the above mix. When mixing mechanically, the water shall be put into the mixer first, then the lime, the white sand if used, and finally the Keene's cement.

3.13.5 High-Strength Gypsum Finish

High-strength gypsum finish shall be mixed by dry weights in proportions of 100 pounds of high-strength gypsum gauging plaster to 45 kg 100 pounds of hydrated lime or 90 kg 200 pounds of lime putty. Gypsum gauging plaster for high-strength finish coat shall be mixed with lime putty in accordance with ASTM C 28. Gauging plaster shall have a compressive strength not less than 21 MPa 3000 psi when tested in accordance with ASTM C 472. Factory-mixed gypsum finishing plasters shall equal or exceed the performance requirements of job-mixed finishing plasters.

3.13.6 Portland Cement-Plaster Finish

The finish coat shall be proportioned and mixed in accordance with ASTM C 926, coat [FL] [F].

3.14 MACHINE APPLICATION

A plastering machine may be used for the application of scratch and brown coats. Plaster for machine application shall be a special plaster compounded and packaged by the manufacturer for this purpose. Slump cone equipment shall be present on the jobsite when base-coat plastering begins, and until completion. Testing of the mix shall be the responsibility of the Contractor, but equipment shall be available for use by the Government. Additional water shall not be added to the mix to allow pumping through extended hose lines to the plastering nozzle. The amount of water added to each batch of plaster shall be that quantity which results in a plaster

slump of not more than 75 mm 3 inches for gypsum and 65 mm2-1/2 inches for portland cement using a standard plaster slump cone or 150 mm 6 inches for gypsum and 125 mm 5 inches for portland cement using a concrete slump cone. Application of plaster shall conform to the provisions of ASTM C 842.

3.15 QUALITY CONTROL

Fluidity or stiffness of plaster shall be tested with a standard 50 x 100 x 150 mm 2 x 4 x 6 inch plaster slump testing cone or by a 100 x 200 x 300 mm 4 x 8 x 12 inch concrete slump testing cone. Method of making slump test shall be as follows:

a. Place cone on center of dry base plate located on a level, firm surface. Hold cone tightly against plate.

b. Fill the cone with plaster obtained from the hose or nozzle, without air on the nozzle, puddling with tamping rod during the operation to eliminate air bubbles or voids.

c. Screed plaster level with top of cone.

d. Lift cone straight up from base plate in a slow and uniform motion, and place it on the base plate next to plaster sample.

e. Lay a straightedge across top of cone, being careful not to disturb or jostle the plate, and measure the slump in millimeters inches from the bottom of the straightedge to the top of the plaster sample.

3.16 APPLICATION OF FINISHES

The finish coat may be omitted back of projecting bases, wainscots, structural-glass wall finish, cabinets, chalkboards, tackboards, bulletin boards, acoustic treatments, fixed equipment, and other locations where indicated. Finish coats shall not be applied above wainscots until wainscots have been installed. Plaster shall have a [[smooth-trowel] [texture] finish] [finish as shown].

3.16.1 Interior Gypsum Plaster

Application of interior gypsum plaster (full thick) shall be in accordance with ASTM C 842. Nominal plaster thickness shall be [as shown] [[_____] mm inches].

3.16.2 Gypsum Veneer Plaster

Application of gypsum veneer plaster shall be in accordance with ASTM C 843. Plaster shall be [[one-component system] [two-component system]] [system as shown].

3.16.3 Lime-Putty Finish

Lime-putty finish shall be applied over gypsum plaster base coats in accordance with ASTM C 842. The finish coat shall be 1.5 to 3 mm1/16 to 1/8 inch thick and troweled smooth and free from blemishes.

3.16.4 Prepared-Gypsum Finish

Prepared-gypsum finish may be used in lieu of lime-putty finish, and shall be applied in accordance with the manufacturer's printed directions.

3.16.5 Keene's Cement Finish and High Strength Gypsum-Plaster Finish

Keene's cement finish and high-strength gypsum-plaster finish shall be

applied in accordance with ASTM C 842. Where indicated on the finish schedule, either may be used at the Contractor's option. Neither finish shall be used over lightweight-aggregate-plaster or portland-cement-plaster base coats. The finish coat shall be 1.5 to 3 mm 1/16 to 1/8 inch thick, and troweled smooth and free from blemishes and irregularities.

3.16.6 Portland Cement-Based Plaster

[Two-coat] [Three-coat] portland cement-based plaster shall be applied in accordance with ASTM C 926. The final coat shall be finished to a true and even surface free from rough areas, checks, or blemishes. Nominal plaster finish thickness shall be [as shown] [[_____] mm inches].

3.17 PATCHING

Plaster showing oversanding, cracks, blisters, pits, checks, discoloration or other defects is not acceptable. Defective plaster work shall be removed and replaced with new plaster at the expense of Contractor. Patching of defective work will be permitted only when approved by the Contracting Officer. Patching shall match existing work in texture and color.

3.18 SAMPLES OF COMPLETED WORK

Samples of completed work may be taken by the Contracting Officer at any time for laboratory inspection and tests to determine conformance.

-- End of Section --

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SECTION 09900

PAINTING, GENERAL

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 in the text by basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

COMMERCIAL ITEM DESCRIPTIONS (CID)

FEDERAL AVIATION ADMINISTRATION (FAA)

FEDERAL SPECIFICATIONS (FS)

MAPLE FLOORING MANUFACTURERS ASSOCIATION (MFMA)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data Paint;

[_____], [_____]

The names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materials [when the required quantity of a particular batch is 200 L 50 gallons or less.] [regardless of quantities in states where VOC content limitations apply.]

Mixing and Thinning; [_____], [_____]
Application; [_____], [_____]

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each coating system. Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and curing and drying times between coats for epoxy, moisture-curing polyurethane, and liquid glaze coatings. Detailed application instructions for textured coatings shall be provided.

SD-04 Samples

Moisture-Curing Polyurethane; [_____], [_____]
A complete moisture-curing polyurethane system applied to a panel of the same material as that on which the coating will be applied in the work and for each color specified. The sample panels will be used for quality control in applying the system.

Paint; [_____], [_____]

While the material is at the site or source of supply, and at a time agreeable to the Contractor and the Contracting Officer, a 1 liter 1 quart sample of each color and batch, except for quantities of 200 liters 50 gallons or less, shall be taken by random selection from

the sealed containers by the Contractor in the presence of a representative of the Contracting Officer. The contents of the containers to be sampled shall be thoroughly mixed to ensure that the sample is representative. Samples shall be identified by designated name, specification number, manufacturer name and address, batch number, project contract number, intended use, and quantity involved.
SD-06 Test Reports Paint; [_____], [_____]

A statement as to the quantity represented and the intended use, plus the following test report for batches in excess of 200 L: 50 gallons:

a. A test report showing that the proposed batch to be used meets specified requirements:

b. A test report showing that a previous batch of the same formulation as the batch to be used met specified requirements, plus, on the proposed batch to be used, a report of test results for properties of weight per liter, gallon, viscosity, fineness of grind, drying time, color, and gloss.

SD-07 Certificates

Lead; [_____], [_____]
Mildewcide and Insecticide; [_____], [_____]
Volatile Organic Compound (VOC) Content; [_____], [_____]

Certificate stating that paints for interior use contain no mercurial mildewcide or insecticide. Certificate stating that paints proposed for use contain not more than 0.06 percent lead by weight of the total nonvolatile. Certificate stating that paints proposed for use meet Federal VOC regulations and those of the of the local Air Pollution Control Districts having jurisdiction over the geographical area in which the project is located.

1.3 PACKAGING, LABELING, AND STORING

Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 20 liters. 5 gallons. Paints and thinner shall be stored in accordance with the manufacturer's written directions and as a minimum stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 4 and 35 degrees C. 40 and 95 degrees F. Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing.

1.4 APPROVAL OF MATERIALS

When samples are tested, approval of materials will be based on tests of the samples; otherwise, materials will be approved based on test reports

furnished with them. If materials are approved based on test reports furnished, samples will be retained by the Government for testing should the materials appear defective during or after application. In addition to any other remedies under the contract the cost of retesting defective materials will be at the Contractor's expense.

1.5 ENVIRONMENTAL CONDITIONS

Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 7 and 35 degrees C 45 and 95 degrees F when applying coatings other than water-thinned, epoxy, and moisture-curing polyurethane coatings. Water-thinned coatings shall be applied only when ambient temperature is between 10 and 32 degrees C. 50 and 90 degrees F. Epoxy, and moisture-curing polyurethane coatings shall be applied only within the minimum and maximum temperatures recommended by the coating manufacturer. Moisture-curing polyurethane shall not be applied when the relative humidity is below 30 percent.

1.6 SAFETY AND HEALTH

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in the CONTRACT CLAUSES. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.6.1 Worker Exposures

Exposure of workers to hazardous chemical substances shall not exceed limits established by ACGIH Limit Values, or as required by a more stringent applicable regulation.

1.6.2 Toxic Compounds

Toxic products having ineffective physiological warning properties, such as no or low odor or irritation levels, shall not be used unless approved by the Contracting Officer.

1.6.3 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material data safety sheets (MDSS) and shall be informed of potential health and safety hazard and protective controls associated with materials used on the project. An affected work area is one which may receive mists and odors from the painting operations. Workers involved in preparation, painting and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

1.6.4 Coordination

Work shall be coordinated to minimize exposure of building occupants, other

Contractor personnel, and visitors to mists and odors from preparation, painting and clean-up operations.

PART 2 PRODUCTS

2.1 PAINT

The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the requirements listed in the painting schedules at the end of this section, except when the required amount of a material of a particular batch is 200 liters 50 gallons or less, an approved first-line proprietary paint material with similar intended formulation, usage and color to that specified may be used. Additional requirements are as follows:

2.1.1 Colors and Tints

Colors shall be as selected from manufacturer's standard colors, as indicated. Manufacturer's standard color is for identification of color only. Tinting of epoxy and urethane paints shall be done by the manufacturer. Stains shall conform in shade to manufacturer's standard color. The color of the undercoats shall vary slightly from the color of the next coat.

2.1.2 Mildewcide and Insecticide

Paint specified for all coats applied to fabrics and vapor barrier jackets over insulation and surfaces in [_____] area shall contain a mildewcide that will not adversely affect the color, texture, or durability of the coating. The mildewcide shall be incorporated into the paint by the manufacturer and shall attain a surface disfigurement rating of 8 or greater when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274. Mercurial mildewcide shall not be used in interior paint. Insecticides shall not be used in paint.

2.1.3 Lead

Paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

2.1.4 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

2.1.5 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards and shall conform to the restrictions of the local air pollution control authority.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primmed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Concrete, Stucco and Masonry Surfaces

Concrete, stucco and masonry surfaces shall be allowed to dry at least 30 days before painting, except concrete slab on grade which shall be allowed to cure 90 days before painting. Surfaces shall be cleaned in accordance with ASTM D 4258. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting. Surfaces to receive polyurethane or epoxy coatings shall be acid-etched or mechanically abraded as specified by the coating manufacturer, rinsed with water, allowed to dry, and treated with the manufacturer's recommended conditioner prior to application of the first coat.

3.2.2 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated, shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be cleaned mechanically with hand tools according to SSPC SP 2, power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7/NACE 4. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

3.2.3 Nonferrous Metallic Surfaces

Galvanized, aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1.

3.2.4 Gypsum Board Surfaces

Gypsum board surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush, rubbing with a cloth, or vacuum-

cleaning prior to application of the first-coat material. A damp cloth or sponge may be used if paint will be water-based.

3.2.5 Mastic-Type Surfaces

Mastic-type surfaces shall be prepared by removing foreign material.

3.2.6 Plaster Surfaces

Plaster shall age at least 30 days before painting. Plaster shall be clean and free from loose matter and shall have an instrument-measured moisture content not exceeding 8 percent.

3.2.7 Wood Surfaces

Wood surfaces shall be cleaned of foreign matter. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter, unless otherwise authorized. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints. Small, dry seasoned knots shall be scraped, cleaned, and given a thin coat of commercial knot sealer, before application of the priming coat. Pitch on large, open, unseasoned knots and all other beads or streaks of pitch shall be scraped off, or, if it is still soft, removed with mineral spirits or turpentine, and the resinous area shall be thinly coated with knot sealer. Finishing nails shall be set, and all holes and surface imperfections shall be primed. After priming, holes and imperfections in finish surfaces shall be filled with putty or plastic wood filler, colored to match the finish coat if natural finish is required, allowed to dry, and sanded smooth. Putty or wood filler shall be compatible with subsequent coatings.

3.2.7.1 Interior Wood Stain

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

3.2.7.2 Sanding of Wood Floors

Sanding of wood floors is specified in Section 09640 WOOD STRIP FLOORING. Floors of oak or similar open-grain wood shall be filled with wood filler recommended by the finish manufacturer and the excess filler removed.

3.2.8 Previously Painted Surfaces

Previously painted surfaces [specified to be repainted] [damaged during construction] shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas. Edges of chipped paint shall be feather edged and sanded smooth. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces

suitable for painting. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8. New, proposed coatings shall be compatible with existing coatings. If existing surfaces are glossy, the gloss shall be reduced.

3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. When thinning is allowed, paints shall be thinned immediately prior to application with not more than 0.125 L 1 pint of suitable thinner per liter. gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.3.1 Cement-Emulsion Filler Coat

Cement and aggregate shall be dry-mixed so that uniform distribution and intermixing are obtained. Mixing liquid and one-half of the total amount of water shall be premixed and added gradually to the white portland cement and aggregate with constant stirring until a thick, smooth material is obtained. Emulsion paint shall then be added to the mixture and stirred until uniformity is obtained. The blend shall have a thick, creamy consistency. The remainder of the water shall be added if necessary to obtain a material with adequate application properties. Blending resin emulsion or emulsion paint with any other component shall be done with caution; too rapid an agitation will cause air entrapment and foaming.

3.3.2 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.4 APPLICATION

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

3.4.1 Ventilation

Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH Limit Values, or as required by a more stringent applicable regulation. Interior work zones having a volume of 280 cubic meters 10,000 cubic feet or less shall be ventilated at a minimum of 2 air exchanges per hour. Ventilation in larger work zones shall be maintained by means of mechanical exhaust. Solvent vapors shall be exhausted outdoors, away from air intakes and workers. Return air inlets in the work zone shall be temporarily sealed before start of work until the coatings have dried.

3.4.2 Respirators

Operators and personnel in the vicinity of operating paint sprayers shall wear respirators.

3.4.3 First Coat

The first coat on plaster, gypsum wallboard, and other surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss. Excess sealer shall be wiped off after each application. The first coat on both faces of wood doors shall be applied at essentially the same time. Glazed doors and sashes shall be given the specified coating system within 3 weeks of the time they are glazed, but not before the glazing material has set; paint shall overlay glass about 1.78 mm 70 mils all around. Each varnish coat shall be sanded lightly prior to application of subsequent coats.

3.4.4 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

3.4.5 Stains

Stain shall be applied at the rate specified in the manufacturer's printed directions. Oil-type stain shall be applied by brushing with the grain for the full length of the board or course of siding.

3.4.6 Fillers

Concrete and masonry surface voids shall be filled; however, surface irregularities need not be completely filled. The dried filler shall be

uniform and free of pinholes. Filler shall not be applied over caulking compound.

3.4.6.1 Cement-Emulsion Filler

Immediately before filler application, surfaces shall be dampened uniformly and thoroughly, with no free surface water visible, by several applications of potable water with a fog spray, allowing time between the sprayings for water to be absorbed. Cement-emulsion filler shall be scrubbed into the surface vigorously with a stiff-bristled brush having tampico or palmyra bristles not longer than 63 mm. 2-1/2 inches. At least 24 hours shall elapse before applying exterior emulsion paint over cement-emulsion filler. When the ambient temperature is over 29 degrees C, 85 degrees F, cement-emulsion filler surfaces shall be dampened lightly with a fog spray of potable water immediately prior to application of the subsequent paint coat.

3.4.6.2 Latex Filler

Latex filler, CID A-A-1500, shall be applied according to the manufacturer's instructions. Surface voids shall be filled and excess filler shall be removed from the surface with a rubber squeegee. The filler shall be allowed to dry the length of time specified by the manufacturer prior to applying successive coats of paint.

3.4.7 Textured Coating

Application of textured coating, FS TT-C-555, shall be as specified in the manufacturer's printed directions.

3.4.8 Ferrous-Metal Primer

Primer for ferrous-metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface. The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

3.5 PIPE COLOR CODE MARKING

Pipes in exposed areas and in accessible pipe spaces shall be provided with color band and titles adjacent to all valves, except those provided at plumbing fixtures, at not more than 12 meter 40 foot spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors. Color code marking shall be of the color listed in TABLE I and the size listed in TABLE II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in TABLE I. Letter sizes shall be as listed in TABLE II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacture. Paint shall be as specified for insulated and uninsulated piping.

TABLE I. COLOR CODES FOR MARKING PIPE

Material	Band	Letters and Arrow*	Legend
Cold water (potable)	Green	White	POTABLE WATER
Fire protection water	Red	White	FIRE PR. WATER
Fire Sprinkler Water	Red	White	FIRE SPR. WATER
Hot water (domestic)	Green	White	H.W.
Hot water recirculating (domestic)	Green	White	H.W.R.
High temp. water supply	Yellow	Black	H.T.W.S.

TABLE I. COLOR CODES FOR MARKING PIPE

Material	Band	Letters and Arrow*	Legend
High temp. water return	Yellow	Black	H.T.W.R.
Boiler feed water	Yellow	Black	B.F.
Low temp. water supply (heating)	Yellow	Black	L.T.W.S.
Low temp. water return (heating)	Yellow	Black	L.T.W.R.
Condenser water supply	Green	White	COND. W.S.
Condenser water return	Green	White	COND. W.R.
Chilled water supply	Green	White	C.H.W.S.
Chilled water return	Green	White	C.H.W.R.
Treated water	Green	White	TR. WATER
Chemical feed	Yellow	Black	CH. FEED
Compressed air	Blue	White	COMP. AIR
Natural gas	Yellow	Black	NAT. GAS
Propane Gas	Yellow	Black	PROP. GAS
Refrigerants	Blue	White	REFRIGERANT
Fuel oil	Yellow	Black	FUEL OIL
Steam	Yellow	Black	STEAM
Condensate	Yellow	Black	CONDENSATE
Hydraulic fluid under 4.1 MPa 600 psi	Green	White	HYDRAULIC FLUID-_____PSI
Hydraulic fluid 4.1 MPa 600 psi and Greater	Yellow	Black	HYDRAULIC FLUID-_____PSI

TABLE II. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (mm)	Width of Color Band (mm)	Arrow Length x Width (mm)	Size of Legend Letters and Numerals (mm)
Less than 38	200	200 x 57	13
38 to 60	200	200 x 57	19
60 to 150	300	200 x 57	31
200 to 225	600	300 x 110	63

Over 250	800	300 x 115	88

TABLE II. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (Inches)	Length of Color Band (inches)	Arrow Length x Width (Inches)	Size of Legend Letters and Numerals (Inches)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4
8 to 10	24	12 x 4-1/2	2-1/2
Over 10	32	12 x 4-1/2	3-1/2

3.6 MISCELLANEOUS PAINTING

3.6.1 Lettering

Lettering shall be provided as scheduled on the drawings, shall be [block] [Gothic] type, and shall be [black enamel] [water-type decalcomania, finished with a protective coating of spar varnish]. Samples shall be approved before application.

3.6.2 Obstructions To Aviation

The following obstructions to aviation shall be painted in the pattern and color prescribed by FAA AC 70/7460-1: [_____]

3.7 SURFACES TO BE PAINTED

Surfaces listed in the painting schedules at the end of this section, other than those listed in paragraph SURFACES NOT TO BE PAINTED, shall be painted as scheduled.

3.8 SURFACES NOT TO BE PAINTED

Surfaces in the following areas shall not to be painted: [_____]. In addition, surfaces of hardware, fittings, and other factory finished items shall not be painted.

3.9 CLEANING

Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable.

3.10 PAINTING SCHEDULES

The following painting schedules identify the surfaces to be painted and prescribe the paint to be used and the number of coats of paint to be applied. Contractor options are indicated by ------or------ between optional systems or coats.

EXTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Concrete masonry units.	Cement-emulsion filler	FS TT-E-2784 Type III	None
	CID A-A-1500	FS TT-E-2784 Type III	None
	FS TT-E-2784 Type III	FS TT-E-2784 Type III	None

NOTE: Cement-emulsion filler coat shall be acrylic-based and shall consist of the following ingredients in the proportion stated: white portland cement, ASTM C 150, Type I, 7.5 kg; 16.5 pounds; aggregate 15 kg; 33.5 pounds; mixing liquid, factory-prepared acrylic containing 46 to 47 percent solids, 3 liters; 0.75 gallon; potable water 4 liters 1.0 gallon maximum; exterior emulsion paint, FS TT-E-2784 Type III 4 liters. 1.0 gallon. Aggregate shall consist of Washed silica sand of the following gradation:

Weight)	U.S. Sieve Size	Percent Sand (by Passing Individual Sieve
	0.850 mm (20)	100
	0.600 mm (30)	95 - 100
	0.300 mm (50)	30 - 65
	0.150 mm (100)	0 - 10
	0.075 mm (200)	0 - 1

Concrete, unless otherwise	FS TT-E-2784 Type III	FS TT-E-2784 Type III specified.	None
Concrete: walls and bottom of swimming pools.	SSPC Paint 18 thin with 1 part of approved thinner to 4 parts of paint	SSPC Paint 18 by volume	SSPC Paint 18
Stucco.	FS TT-E-2784 Type III	FS TT-E-2784 Type III	None
	Primer as recommended by FS TT-C-555	FS TT-C-555 Type II	None

EXTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Wood, unless otherwise specified.	CID A-A-2336	FS TT-E-2784 Type [_____]	FS TT-E-2784 Type [_____]
	FS TT-E-2784 Type III	FS TT-E-2784 Type [_____]	FS TT-E-2784 Type [_____]
Wood: Steps, platforms, floors, of open porches, [_____].	FS TT-E-2784 Type III	FS TT-E-2784 Type I	FS TT-E-2784 Type I
Wood: stain finish.	FS TT-S-708	None	None
	FS TT-S-001992 Class B	FS TT-S-001992 Class B	None
Hardboard: factory primed.	FS TT-E-2784 Type [_____]	FS TT-E-2784 Type [_____]	None
Ferrous metal unless otherwise specified	SSPC Paint 5	CID A-A-2962 Type I Class [_____] Grade C	CID A-A-2962 Type 1 Class [_____] Grade C
	SSPC Paint 25	CID A-A-2962 Type I Class [_____]	CID A-A-2962 Type 1 Class [_____]
Grade C	Grade C		
	SSPC Paint 23	FS TT-E-2784 Type [I] [II]	FS TT-E-2784 Type [I] [II]
Ferrous metal: subject	SSPC Paint 20 Type I to high temperature, up to 232 degrees C (450 degrees F), as follows: [_____].	None	None

EXTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat

Ferrous metal: subject to high temperature, from 232 degrees C to 649 degrees C (450 degrees F to 1200 degrees F), as follows: [____].	FS TT-P-28	FS TT-P-28	None

NOTE: Commercial blast-cleaning, SSPC SP 6/NACE 3 required. No pretreatment. Maximum total system thickness: 0.102 mm.4 mil.

Galvanized metal.	FS TT-E-2784 Type III	FS TT-E-2784 Type [_____]	FS TT-E-2784 Type [_____]
Aluminum aluminum-alloy, and other non-ferrous metal (non-galvanized)	CID A-A-2867 FS TT-E-2784 Type III	CID A-A-2867 FS TT-E-2784 Type [_____]	None FS TT-E-2784 Type [_____]
	Aviation Obstructions		
Masonry & Concrete	FS TT-E-2784 Type III	FS TT-E-2784 Type I	None
	Aviation Obstructions		
Ferrous Metal	SSPC Paint 25	CID A-A-2962 Type I Class [_____]	CID A-A-2962 Type I Class [_____]
Grade C	Grade C		
	CID A-A-2867	CID A-A-2867	None
	SSPC Paint 23	FS TT-E-2784 Type I	FS TT-E-2784 Type I

INTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Plaster, gypsum board, concrete, concrete units requiring a smooth finish, unless otherwise specified	CID A-A-2994 Type II	CID A-A-2246 or CID A-A-2247	CID A-A-2246 on gypsum board and faced with masonry recycled paper not required a smooth finish, CID A-A-2247 on gypsum board faced with recycled paper
gypsum board with		CID A-A-2248	CID A-A-2248 on faced recycled paper
Concrete masonry 2246 units requiring finish	CID A-A-1500	CID A-A-2994 Type II or CID A-A-2247 or CID A-A-2248	CID A-A- a smooth
Concrete: ceilings in TT-C-555 [_____].	Primer as recommended by manufacturer	FS TT-C-555 Type I	None following areas: FS
Concrete: floors requiring dust [_____].	CID A-A-2542 Type I	None reduction in following areas	None
Concrete masonry units in serving, restrooms and laundry areas, unless otherwise specified	CID A-A-1500	CID A-A-2994 Type II	FS TT-E-2784 food-preparation, food-
Plaster and gypsum board: in food-preparation food-serving restrooms and areas, unless otherwise specified.	CID A-A-2994 Type II	FS TT-E-2784 Type [_____]	FS TT-E-2784 Type [_____] on gypsum board faced with recycled paper laundry

Concrete masonry units: in,	CID A-A-1500	CID A-A-2994 Type II	FS TT-E-2784 Type [___]

shower areas, and areas requiring a high degree of sanitation, unless otherwise specified.

Plaster and gypsum board: in shower areas, and areas requiring a high recycled degree of paper sanitation, unless otherwise specified.	CID A-A-2994 Type II	FS TT-E-2784 Type [_____]	FS TT-E-2784 Type [_____] on gypsum board faced with
Concrete masonry units, plaster, and gypsum board: for walls in heavy traffic areas in space as follows:	CID A-A-1500	CID A-A-2994 Type II	CID A-A-2246 -----or----- CID A-A-2247
Hardboard. Type I	CID A-A-2994	CID A-A-2246	CID A-A-2246
		----------or----------	
		CID A-A-2247	CID A-A-2247
		----------or----------	
		CID A-A-2248	CID A-A-2248
Ferrous Metal unless otherwise specified	SSPC Paint 25	CID A-A-2962 Type I Class [_____] Grade C	CID A-A-2962 Type I Class [_____] Grade C
	SSPC Paint 23	FS TT-E-2784 Type [I] [II]	FS TT-E-2784 Type [I] [II]
	CID A-A-2867	CID A-A-2867	None
Aluminum and aluminum alloy unless otherwise specified.	CID A-A-2867	CID A-A-2867	None
	FS TT-E-2784 Type III	FS TT-E-2784 Type [I] [II]	FS TT-E-2784 Type [I] [II]
Ferrous metal in concealed damp spaces or in exposed areas having unpainted adjacent surfaces as follows: [_____]	CID A-A-1632	None	None

Ferrous metal factory-primed equipment.	Two coats of paint as recommended by the equipment manufacturer mechanical and electrical		None
Galvanized metal:	FS TT-E-2784 Type III	FS TT-E-2784 Type [_____]	None
	SSPC Paint 5	CID A-A-2962 Type I Class [_____] Grade C	CID A-A-2962 Type I Class [_____] Grade C
	SSPC Paint 25	CID A-A-2962 Type I Class [_____] Grade C	CID A-A-2962 Type I Class [_____] Grade C
	SSPC Paint 23	FS TT-E-2784 Type [_____]	FS TT-E-2784 Type [_____]
Wood: unless otherwise specified.	CID A-A-2994 Type I	CID A-A-2246 -----or----- CID A-A-2247 -----or----- CID A-A-2248	None None None
Wood: stain and varnish finishes as follows: [___]	Commercially available stain	CID A-A-1788 Type [_____] Class I In addition a fourth coat of CID A-A-1788 Type [_____] Class I	CID A-A-1788 Type [_____] Class I
	CID A-A-2339	CID A-A-2834 Type I Class [_____] In addition a fourth coat of CID A-A-2834 Type I Class [_____]	CID A-A-2834 Type I Class [_____]

Wood: floors to receive paint finish.	CID A-A-2994 Type I	FS TT-E-2784 Type [_____] Type I or II	FS TT-E-2784 Type [_____] Type I or II
Wood: floors, except gymnasium Class A spaces as follows. [_____]	FS TT-C-542 Type I, Class A	FS TT-C-542 Type I, floors, to receive stain or natural finish in	None
Wood: gymnasium Oleoresinous gymnasium finish.	CID A-A-2335	CID A-A-2335	type floor per MFMA-03
	FS TT-C-542 Type I, Class A	FS TT-C-542 Type I, Class A	None
Wood: handrails.	CID A-A-1788 Type [_____] Class [_____]	CID A-A-1788 Type [_____] Class [_____]	CID A-A-1788
	CID A-A-1546	CID A-A-1546	CID A-A-1546
Wood: natural finish as follows: [_____]	CID A-A-1546	CID A-A-1546	CID A-A-1546
Ferrous Metal:			
Convector enclosures, electrical conduit runs: metallic tubing uninsulated ducts and pipes, pipe hangers, louvers, grilles, and air outlets, in areas having painted adjacent surfaces.	SSPC Paint 23	None	None
Aluminum and Galvanized Surface Metal:			
Convector enclosures, electrical conduit runs metallic tubing uninsulated ducts and pipes, pipe hangers, louvers, grilles, and air outlets, in areas having painted adjacent surfaces.	FS TT-E-2784	CID A-A-2246 or CID A-A-2247 or CID A-A-2248	CID A-A-2246 or CID A-A-2247 or CID A-A-2248

Metal: surfaces subject to high F), as follows: [_____].	SSPC Paint 20 Type I temperature, up to 232 degrees C (450 degrees	None	None
Metal: surfaces subject to temperature from 232 degrees C to 649 degrees C (450 degrees F to 1200 degrees F), as follows: [_____].	FS TT-P-28	FS TT-P-28	None

NOTE: Commercial blast-cleaning, SSPC SP 6/NACE 3 or better required. No pretreatment. Maximum total dry film thickness: 0.102 mm.4 mil.

Facing of vapor barrier jackets finished cloth cover insulation on pipes, ducts, and equipment in following area. [_____]	Two coats of paint to match of presized or adjacent areas		None adhesive

-- End of Section --

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SECTION 15400

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SECTION 15400
PLUMBING, GENERAL PURPOSE

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 in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

AMERICAN SOCIETY OF SANITARY ENGINEERING FOR PLUMBING AND SANITARY

RESEARCH(ASSE)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AMERICAN WELDING SOCIETY (AWS)

CAST IRON SOIL PIPE INSTITUTE (CISPI)

COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

HYDRAULIC INSTITUTE (HI)

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANCIAL OFFICIALS (IAPMO)

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

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NSF INTERNATIONAL (NSF)

PLUMBING AND DRAINAGE INSTITUTE (PDI)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

UNDERWRITERS LABORATORIES (UL)

1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Welding

[Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The

Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.] [Welding and nondestructive testing procedures are specified in Section 05093WELDING PRESSURE PIPING.]

1.3.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with [Section 13110 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 13112 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)].

1.4 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be

submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; [_____], [_____].

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Schematics; [_____], [_____].

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

SD-03 Product Data

Welding; [_____], [_____].

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing Fixture Schedule; [_____], [_____].

Catalog cuts of [specified plumbing fixtures] [valves] [and] [related piping].

Vibration-Absorbing Features; [_____], [_____].

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System; [_____], [_____].

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection; [_____], [_____].

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests; [_____], [_____]..

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment; [_____], [_____].

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. The label or listing of the specified agency will be acceptable evidence.

In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts; [_____], [_____].

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

SD-10 Operation and Maintenance Data

Plumbing System; [_____], [_____].

[Six] [_____] copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. [Six] [_____] copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

1.6 REGULATORY REQUIREMENTS

Plumbing work shall be in accordance with NAPHCC Plumbing Code.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead

shall not be used in any potable water system. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Couplings for Grooved Pipe: [Ductile Iron ASTM A 536 (Grade 65-45-12)] [Malleable Iron ASTM A 47/A 47M, Grade 32510]. [Copper ASTM A 536].

d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1.6 mm (1/16 inch) 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

e. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.

f. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.

g. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.

h. Solder Material: Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

i. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

j. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.

k. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

l. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 110 degrees C (230 degrees F). 230 degrees F.

m. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

n. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.

o. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.

p. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.

q. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.

r. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.

s. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

t. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201.

b. Copper, Sheet and Strip for Building Construction: ASTM B 370.

c. Asphalt Roof Cement: ASTM D 2822.

d. Hose Clamps: SAE J 1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines:

AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Polyethylene Encasement for Ductile-Iron Piping: AWWA C105.

l. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.

m. Thermometers: ASTM E 1.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm (2-1/2 inches) 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm (3 inches) 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34

Description	Standard
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85

Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ASSE 1001
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 20 mm (3/4 inch) 3/4 inch male inlet threads, hexagon shoulder, and 20 mm (3/4 inch) 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.3 Wall Hydrants

Wall hydrants with vacuum-breaker backflow preventer shall have a nickle-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 20 mm (3/4 inch) 3/4 inch exposed hose thread on spout and 20 mm (3/4 inch) 3/4 inch male pipe thread on inlet.

2.3.4 Lawn Faucets

Lawn faucets shall be brass, with either straight or angle bodies, and shall be of the compression type. Body flange shall be provided with internal pipe thread to suit 20 mm (3/4 inch) 3/4 inch pipe. Body shall be suitable for wrench grip. Faucet spout shall have 20 mm (3/4 inch) 3/4

inch exposed hose threads. Faucet handle shall be securely attached to stem. 2.3.5 Yard Hydrants

Yard box or post hydrants shall have valve housings located below frost lines. Water from the casing shall be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

2.3.6 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 59 kW (200,000 Btuh) 200,000 Btuh shall have 20 mm (3/4 inch) 3/4 inch minimum inlets, and 20 mm (3/4 inch) 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW (200,000 Btuh)200,000 Btuh shall have 25 mm (1 inch) 1 inch minimum inlets, and 25 mm (1 inch) 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.7 Thermostatic Mixing Valves

Mixing valves, thermostatic type, shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 2 degrees C 5 degrees F of any setting.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with NAPHCC Plumbing Code. Fixtures for use by the physically handicapped shall be in accordance with CABO A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts

of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 82 degrees C (180 degrees F) 180 degrees F water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

2.4.1 Lavatories

[Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled.] [Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.]

2.4.2 Automatic Flushing System

Flushing system shall consist of solenoid-activated flush valve with [electrical-operated light beam sensor] [pushbutton] to energize solenoid. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-01. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains

shall be provided with threaded or caulked connection. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.21.1M.

2.6.1.1 Metallic Shower Pan Drains

Where metallic shower pan membrane is installed, polyethylene drain with corrosion-resistant screws securing the clamping device shall be provided. Polyethylene drains shall have fittings to adapt drain to waste piping. Polyethylene for floor drains shall conform to ASTM D 1248. Drains shall have separate cast-iron "P" trap, circular body, seepage pan, and strainer, unless otherwise indicated.

2.6.1.2 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.6.2 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 300 mm (12 inch) 12 inch nominal overall width or diameter and 250 mm (10 inch) 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.21.1M.

2.6.3 Floor Sinks

Floor sinks shall be [circular] [square], with 300 mm (12 inch) 12 inch nominal overall width or diameter and 250 mm (10 inch) 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.4 Boiler Room Drains

Boiler room drains shall have combined drain and trap, hinged grate, removable bucket, and threaded brass cleanout with brass backwater valve. The removable galvanized cast-iron sediment bucket shall have rounded corners to eliminate fouling and shall be equipped with hand grips. Drain shall have a minimum water seal of 100 mm (4 inches). 4 inches. The grate area shall be not less than 0.065 square meters (100 square inches). 100 square inches.

2.6.5 Pit Drains

Pit drains shall consist of a body, integral seepage pan, and nontilting perforated or slotted grate. Drains shall be of double drainage pattern

suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps, unless otherwise indicated.

2.6.6 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded or caulked connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar	0.023 square meters (36 square inches)	36 square inches
Height of funnel	95 mm (3-3/4 inches)	3-3/4 inches
Diameter of lower portion of funnel	50 mm (2 inches)	2 inches
Diameter of upper portion of funnel	100 mm (4 inches)	4 inches

2.6.7 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.21.2M, with dome and integral

flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and

gaskets or packing. The sleeve shall have a nominal thickness of not less than 3.416 mm (0.134 inch). 0.134 inch. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.7 SHOWER PAN

Shower pan may be copper, or nonmetallic material.

2.7.1 Sheet Copper

Sheet copper shall be 4.9 kg per square meter (16 ounce) 16 ounce weight.

2.7.2 Plasticized Polyvinyl Chloride Shower Pan Material

Material shall be sheet form. The material shall be 1.016 mm (0.040 inch) 0.040 inch minimum thickness of plasticized polyvinyl chloride or chlorinated polyethylene and shall be in accordance with ASTM D 4551.

2.7.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material

Material shall consist of a plastic waterproofing membrane in sheet form. The material shall be 1.016 mm (0.040 inch) 0.040 inch minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. ASTM D 638M or ASTM D 638:

Ultimate Tensile Strength: 1.79 MPa (2600 psi) 2600 psi
Ultimate Elongation: 398 percent
100 Percent Modulus: 3.07 MPa (445 psi) 445 psi

b. ASTM D 1004:

Tear Strength: 53 kilonewtons per meter (300 pounds per inch) 300 pounds per inch

c. ASTM E 96:

Permeance: 0.46 ng per Pa per second per square meter (0.008 perms) 0.008 perms

d. Other Properties:

Specific Gravity: 1.29
PVC Solvent: Weldable
Cold Crack: minus 47 degrees C (-53 degrees F) -53 degrees F
Dimensional stability,
100 degrees C (212 minus 2.5 percent degrees F) 212 degrees F minus 2.5 percent
Hardness, Shore A: 89

2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.813 mm (0.032 inch) 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 50 mm (2 inches). 2 inches. The interior diameter shall be not more than 3.2 mm (1/8 inch) 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.9 GREASE INTERCEPTOR

Grease interceptor of the size indicated shall be of reinforced concrete, [or precast concrete construction] [or equivalent capacity commercially available steel grease interceptor] with removable three-section, 9.5 mm (3/8 inch) 3/8 inch checker-plate cover, and shall be installed outside the building. Steel grease interceptor shall be installed in a concrete pit and shall be epoxy-coated to resist corrosion as recommended by the manufacturer. Interceptors shall be tested and rated in accordance with PDI G 101. Concrete shall have 21 MPa 3,000 psi minimum compressive strength at 28 days.

2.10 WATER HEATERS

Water heater types and capacities shall be as indicated. Each primary water heater shall have controls with an adjustable range that includes 32 to 49 degrees C (90 to 120 degrees F). 90 to 120 degrees F. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 49 to 82 degrees C (120 to 180 degrees F). 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 2000 liters 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is not insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.10.1 Automatic Storage Type

Heaters shall be complete with [control system,] [control system, temperature gauge, and pressure gauge,] and shall have ASME rated combination pressure and temperature relief valve.

2.10.1.1 Oil-Fired Type

Oil-fired type water heaters shall conform to UL 732.

2.10.1.2 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1 when input is 22 KW (75,000 BTU per hour) 75,000 BTU per hour or less or ANSI Z21.10.3 for heaters with input greater than 22 KW (75,000 BTU per hour). 75,000 BTU per hour.

2.10.1.3 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 4.5 KW. The elements shall be wired so that only one element can operate at a time.

2.10.1.4 Indirect Heater Type

Steam and high temperature hot water (HTHW) heaters shall be the assembled product of one manufacturer, and be ASME tested and "U" stamped to code requirements under ASME BPV VIII Div 1. The storage tank shall be as specified in paragraph HOT-WATER STORAGE TANKS. The heat exchanger shall be double wall type that separates the potable water from the heat transfer medium with a space vented to the atmosphere in accordance with NAPHCC Plumbing Code. [The coil shall be coated as specified in paragraph Water Heater, Phenolic Resin Coatings.]

a. HTHW Energy Source: The heater element shall have a working pressure of 2758 kPa 400 psig with water at a temperature of 204 degrees C. 400 degrees F. The heating surface shall be based on 0.093 square meter 1 square foot of heating surface to heat 76 L 20 gallons or more of water in 1 hour from 4 to 82 degrees C 40 to 180 degrees F using hot water at a temperature of 178 degrees C. 350 degrees F. Carbon steel heads shall be used. Tubing shall conform to ASTM B 111M ASTM B 111, Copper Alloy No. 706 (90-10 copper-nickel). Heating elements shall withstand an internal hydrostatic pressure of 4137 kPa 600 psig for not less than 15 seconds without leaking or any evidence of damage.

b. Steam Energy Source: The heater element shall have a working pressure of 1034 kPa per square meter 150 pounds per square inch gauge (psig) with steam at a temperature of 185 degrees C. 365 degrees F. The heating surface shall be based on 0.093 square meter 1 square foot of heating surface to heat 76 L20 gallons or more of water in 1 hour from 4 to 82 degrees C40 to 180 degrees F using steam at atmospheric pressure. [Cast iron] [bronze] heads shall be used. Tubing shall be light-drawn copper tubing conforming to ASTM B 75M ASTM B 75. Heating elements shall withstand an internal hydrostatic pressure of 1551 kPa 225 psig for not less than 15 seconds without leaking or any evidence of damage.

2.10.2 Instantaneous Water Heater

Heater shall be crossflow design with service water in the coil and [steam] [hot water] in the shell. An integral internal controller shall be provided, anticipating a change in demand so that the final temperature can be maintained under all normal load conditions when used in conjunction with [pneumatic control system] [pilot-operated temperature control system]. Unit shall be manufactured in accordance with ASME BPV VIII Div 1, and shall be certified for 1.03 MPa (150 psi) 150 psi working pressure in the shell and 1.03 MPa (150 psi) 150 psi working pressure in the coils. Shell shall be carbon steel with copper lining. Heads shall be [cast iron] [bronze] [carbon steel plate with copper lining]. Coils shall be [copper] [copper-nickel]. Shell shall have metal sheathed fiberglass insulation, combination pressure and temperature relief valve, and thermometer. Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.10.3 Phenolic Resin Coatings

The phenolic resin coating shall be applied at either the coil or coating manufacturer's factory. The coil shall be chemically cleaned to remove any scale if present and to etch the metal surface. The exposed exterior surface of the coil shall be abrasively cleaned to white metal blast in accordance with SSPC SP 5/NACE 1. The coating shall be a product specifically intended for use on the material the water heating coils are made of. Steel, copper, copper alloy, or stainless steel coatings shall be capable of withstanding temperatures up to 204 degrees C (400 degrees F) 400 degrees F dry bulb; and meet the requirements of 21 CFR 175. [The entire exterior surface] [and] [the first 125 mm (5 inches) to 200 mm (8 inches) 5 to 8 inches inside the tubes] of each coil shall be coated with three component phenolic resin coating system. The system shall consist of the following: wash primer, pigmented base coat, the clear top coat. Immediate and final cure times and temperatures shall be as recommended by the coating manufacturer.

2.10.3.1 Wash Primer

The wash primer shall be composed of a combination of polyvinyl butyral and a heat hardening phenolic resin. The weight per liter (gallon) gallon shall be between 0.8388 kg per liter (7.0 lbs. per gallon) 7.0 lbs per gallon minimum and 0.8867 kg per liter (7.4 lbs. per gallon) 7.4 lbs. per gallon maximum.

2.10.3.2 Pigmented Base Coat

The pigmented baking phenolic base coat shall consist of heat hardening phenolic resins, suitable pigments of the earth type, and softening agents, and shall not contain drying oils or cellulose material. The weight per liter (gallon) gallon shall be between 1.2 kg per liter (10.3 lbs per gallon) 10.3 lbs per gallon minimum and 1.3 kg per liter (10.7 lbs per gallon) 10.7 lbs per gallon maximum. The non-volatile solids content shall be between 60 percent minimum and 64 percent maximum by weight.

2.10.3.3 Clear Top Coat

The clear non-pigmented baking phenolic top coat shall have a weight per liter (gallon) gallon of between 1.0 kg per liter (8.65 lbs per gallon) 8.65 lbs per gallon minimum and 1.1 kg per liter (8.95 lbs per gallon) 8.95 lbs per gallon maximum. The non-volatile solids content shall be between 48 percent minimum and 52 percent maximum by weight.

2.10.3.4 Certificate of Compliance

A certificate of compliance shall be submitted by the coating manufacturer that documents successful use of coating system under service conditions indicated on the drawings for a minimum of 2 years at three different locations, and that the coating material and application comply with the testing procedures outlined.

2.10.3.5 Test Panels

Steel test panel substrate shall be 0.607 mm (24 gauge) 24 gauge in thickness. The panels shall be coated with one coat wash primer, then pigmented baking phenolic to a dry film thickness of 0.10 to 0.15 mm, 4 to 6 mil, then clear baking phenolic to a total dry film thickness of 0.13 to 0.18 mm. 5 to 7 mil. The panels shall then be subjected to the tests specified below:

a. Heat Test: Test panel shall be minimum 70 x 150 mm 2-3/4 x 5-7/8 inches in size. A coated test panel shall show no cracking, flaking, or other failure after the panel has been tested in accordance with ASTM D 2485, with a furnace temperature of 204 degrees C (400 degrees F). 400 degrees F.

b. Abrasion Test: A coated test panel shall show no more than a 40 milligram loss when tested in accordance with ASTM D 4060, utilizing a Tabor Abraser CS-17F wheel with a 1000 g weight for 1000 cycles.

c. Corrosion Test: A coated test panel shall show no corrosion after being subjected to a 500 hour salt spray test in accordance with ASTM B 117.

2.11 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1. Each tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 175 mm (7 inch) 7 inch scale. Thermometer shall have a separable socket suitable for a 20 mm (3/4 inch) 3/4 inch tapped opening. Tanks shall be equipped with a pressure gauge 155 mm (6 inch) 6 inch minimum diameter face. Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.12 PUMPS

2.12.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type [1] [4] enclosed, across-the-line, magnetic controller. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 75 and 150 mm 3 and 6 inches above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type [1] [4] enclosure, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

2.12.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump capacities, efficiencies, motor sizes, speeds, and impeller types shall be as shown. Pump and motor shall be [integrally mounted on a cast-iron or steel subbase,] [close-coupled with an overhung impeller,] [or] [supported by the piping on which it is installed]. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient wattage (horsepower) horsepower for the service required. Pump shall conform to HI 1.1-1.5. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover. Pump motors smaller than 746 W (Fractional horsepower pump motors) Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Guards shall shield exposed moving parts.

2.12.3 Booster Pumps

2.12.3.1 Centrifugal Pumps

Horizontal split-case centrifugal-type booster pumps shall be furnished. The capacities shall be as shown, and the speed shall not exceed 1800 rpm. Pumps shall have a casing of close-grained iron or steel with smooth water passages. A gasket shall be provided between the upper and lower halves of the casing. Suction and discharge connections shall be flanged. Impellers shall be nonoverloading, bronze, balanced to eliminate vibration, and shall

be keyed to corrosion-resisting steel shafts. The casings shall be fitted with bronze wearing or sealing rings. Bearings shall be cartridge type, enabling the entire rotating element to be removed without disturbing alignment or exposing the bearings to dirt, water, and other foreign matter. Pumps shall be provided with mechanical seals. Seal boxes shall be machined in the pump casing and at both sides of the pump, and shall be of sufficient depth to include a conventional bronze seal ring and rows of shaft packing. Bedplates shall be close-grain cast iron or steel with ribs and lugs, complete with foundation bolts, and shall have a drip lip with drain hole. Each pump shall be tested at the manufacturer's plant for operating characteristics at the rated capacity and under specified operating conditions. Test curves shall be furnished showing capacity in liters per second (gpm), gpm, head in meters (feet), feet,efficiency, brake wattage (horsepower), horsepower, and operation in parallel with similar pumps. Multiple pump installations shall have pump characteristics compatible for operation in parallel with similar pumps. The electric motor shall be sized for non-overload when operating at any point along the characteristic curve of the pump. Guards shall shield exposed belts and moving parts.

2.12.3.2 Controls

Each pump motor shall be provided with enclosed across-the-line-type magnetic controller complete in a NEMA 250 Type 1 enclosure with three position, "HAND-OFF-AUTOMATIC," selector switch in cover. Pumps shall be automatically started and stopped by float or pressure switches, as indicated. The pumps shall start and stop at the levels and pressures indicated. A multiposition sequence selector switch shall be provided so that any two pumps may be operated simultaneously beeping a third pump as a standby.

2.12.4 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.13 WATER PRESSURE BOOSTER SYSTEM

2.13.1 Constant Speed Pumping System

Constant speed pumping system with pressure-regulating valves shall employ one lead pump for low flows, and one or more lag pumps for higher flows. Pressure-regulating valves shall be provided with nonslam check feature. The factory prepiped and prewired assembly shall be mounted on a steel frame, complete with pumps, motors, and automatic controls. The system capacity and capacity of individual pumps shall be as indicated. Current sensing relays shall provide staging of the pumps. The pumps shall be protected from thermal buildup, when running at no-flow, by a common thermal relief valve. Pressure gauges shall be mounted on the suction and discharge headers. The control panel shall bear the UL listing label for industrial control panels and shall be in a NEMA 250, Type 1 enclosure. The

control panel shall include the following: No-flow shutdown; 7-day time clock; audiovisual alarm; external resets; manual alternation; magnetic motor controllers; time delays; transformer; current relays; "HAND-OFF-AUTOMATIC" switches for each pump; minimum run timers; low suction pressure cutout; and indicating lights for power on, individual motor overload, and low suction pressure. The control circuit shall be interlocked so that the failure of any controller shall energize the succeeding controller.

2.13.2 Hydro-Pneumatic Water Pressure System

An ASME code constructed tank stamped for 862 kPa (125 psig) 125 psig water working pressure shall be provided. The tank shall have a flexible diaphragm made of material conforming to FDA requirements for use with potable water and shall be factory precharged to meet required system pressure.

2.13.3 Variable Speed Pumping System

Variable speed pumping system shall provide system pressure by varying speed and number of operating pumps. The factory prepiped and prewired assembly shall be mounted on a steel frame complete with pumps, variable speed drives, motors, and controls. The variable speed drives shall be the oil-filled type capable of power transmission throughout their complete speed range without vibration, noise, or shock loading. Each variable speed drive shall be run-tested by the manufacturer for rated performance, and the manufacturer shall furnish written performance certification. System shall have suppressors to prevent noise transmission over electric feed lines. Required electrical control circuitry and system function sensors shall be supplied by the variable speed drive manufacturer. The primary power controls and magnetic motor controllers shall be installed in [the controls supplied by the drive manufacturer] [the motor control center]. The sensors shall be located in the system to control drive speed as a function of [constant pump discharge pressure] [constant system pressure at location indicated]. Connection between the sensors and the variable speed drive controls shall be accomplished with [hydraulic sensing lines] [copper wiring] [telemetry]. Controls shall be in NEMA 250, Type 1 enclosures.

2.14 COMPRESSED AIR SYSTEM

2.14.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including [_____] phase, [_____] volt motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type [1] [4] enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall [start and stop automatically at upper and lower pressure limits of the system] [regulate pressure by constant speed compressor loading and unloading] [have a manual-off-automatic switch that when in the manual position, the compressor loads and unloads to meet the demand and, in the automatic position, a time delay relay shall allow the compressor to operate for an adjustable length of time unloaded, then

stop the unit]. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with [automatic] [manual] alternation system. Each compressor motor shall be provided with an across-the-line-type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensates before the air enters the receiver. Aftercoolers shall be either air- or water-cooled, as indicated. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

2.14.2 Lubricated Compressors

Compressors shall be two-stage, V-belt drive, capable of operating continuously against their designed discharge pressure, and shall operate at a speed not in excess of 1800 rpm. Compressors shall have the capacity and discharge pressure indicated. Compressors shall be assembled complete on a common subbase. The compressor main bearings shall be either roller or ball. The discharge passage of the high pressure air shall be piped to the air receiver with a copper pipe or tubing. A pressure gauge calibrated to 1.03 MPa (150 psi) 150 psi and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to pressure switches.

2.14.3 Air Receivers

Receivers shall be designed for 1.38 MPa (200 psi) 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPV VIII Div 1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

2.14.4 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 862 kPa (125 psi), 125 psi, capacity as indicated.

2.14.5 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 862 kPa (125 psi) 125 psi and a maximum temperature of 93 degrees C (200 degrees F). 200 degrees F.

Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 kPa to 862 kPa (0 to 125 psi). 0 to 125 psi. Regulator shall be sized as indicated.

2.15 DOMESTIC WATER SERVICE METER

Cold water meter shall be of the positive displacement type conforming to AWWA C700. Meter register may be round or straight reading type, [indicating [_____]] [as provided by the local utility]. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m 5 feet outside the building, unless otherwise indicated. A [gate valve] [full port ball valve] [ball valve] and drain shall be installed on the water service line inside the building approximately 150 mm 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 300 mm 12 inches below the [average local frost depth] [finish grade] or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 12 mm 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific excepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 20 mm (3/4 inch) 3/4 inch hose bibb with renewable seat and [gate] [full port ball] [ball] valve ahead of hose bibb. At other low points, 20 mm (3/4 inch) 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as

required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 15 m 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 862 kPa (125 psig) 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. 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, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling

manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.3.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm (2-1/2 inches) 2-1/2 inches and smaller; flanges shall be used on pipe sizes 80 mm (3 inches) 3 inches and larger.

3.1.3.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.5 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections. Connections shall be made with a multiflame torch.

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA Tube Handbook with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 50 mm (2 inches) 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA Tube Handbook.

c. Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to ensure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC Plumbing Code using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

3.1.3.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3.7 Glass Pipe

Joints for corrosive waste glass pipe and fittings shall be made with corrosion-resisting steel compression-type couplings with acrylonitrile rubber gaskets lined with polytetrafluoroethylene.

3.1.3.8 Corrosive Waste Plastic Pipe

Joints for polyolefin pipe and fittings shall be made by mechanical joint or electrical fusion coil method in accordance with ASTM D 2657 and ASTM F 1290. Joints for filament-wound reinforced thermosetting resin pipe shall be made in accordance with manufacturer's instructions. Unions or flanges shall be used where required for disconnection and inspection.

3.1.3.9 Other Joint Methods

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Corrosion Protection for Buried Pipe and Fittings

3.1.5.1 Cast Iron and Ductile Iron

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA C105. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.5.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for cast-iron soil pipe passing

through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 100 mm 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 6 mm (1/4 inch) 1/4 inch clearance between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves for membrane waterproof floors shall be steel pipe, cast-iron pipe, or plastic pipe. Membrane clamping devices shall be provided on pipe sleeves for waterproof floors. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Plastic sleeves shall not be used in nonbearing fire walls, roofs, or floor/ceilings. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07900 JOINT SEALING. Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above. The annular space between pipe and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 12 mm 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and [concrete] [masonry] wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

3.1.6.2 Flashing Requirements

Pipes passing through roof or floor waterproofing membrane shall be installed through a 4.9 kg per square meter (16 ounce) 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the

pipe a minimum of 250 mm. 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 200 mm 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 250 mm (10 inches) 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.6.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 40 mm 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 40 mm; 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 200 mm 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 40 mm 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 150 mm (6 inches) 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 6 to 13 mm 1/4 to 1/2 inch wide by 6 to 10 mm 1/4

to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07900 JOINT SEALING.

3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 50 mm (2 inches) 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.8.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT [as shown]. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05120 STRUCTURAL STEEL.

3.1.8.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 100 mm (4 inches) 4 inches and larger when the temperature of the medium is 15 degrees C 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 100 mm (4 inches). 4 inches.

(2) Be used on insulated pipe 100 mm (4 inches) 4 inches and larger when the temperature of the medium is 15 degrees C 60 degrees F or less.

(3) Have a high density insert for pipe 50 mm (2 inches) 2 inches and larger and for smaller pipe sizes when the insulation is suspected of being visibly compressed, or distorted at or near the shield/insulation interface. High density inserts shall have a density of 128 kg per cubic meter (8 pcf) 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 49 degrees C 120 degrees F for PVC and 82 degrees C 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m 15 feet nor more than 2 m 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 40 shields used on insulated pipe shall have high density inserts with a density of 128 kg per cubic meter (8 pcf) 8 pcf or greater.

l. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed.

Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 100 mm (4 inches) 4 inches and larger when the temperature of the medium is 15 degrees C 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 100 mm (4 inches) 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 100 mm (4 inches) 4 inches and larger carrying medium less that 15 degrees C 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

m. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

n. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm 4 inches or by an amount adequate for the insulation, whichever is greater.

o. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.9 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.10 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm (4 inches) 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be

flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 100 mm (4 inches). 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 450 mm 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be [cast iron] [or] [plastic].

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 150 mm 6 inches above the top of the tank or water heater.

3.2.2 Installation of Gas- and Oil-Fired Water Heater

Installation shall conform to NFPA 54 for gas fired and NFPA 31 for oil fired. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 600 mm 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

3.2.3 Phenolic Resin Application Process

The phenolic resin coating shall be applied at either the coil or coating manufacturer's factory. The [steam] [hot water] coil shall be chemically cleaned to remove any scale if present and to etch the metal surface. The exposed exterior surface of the coil shall be abrasively cleaned to white metal blast in accordance with SSPC SP 5/NACE 1. The exterior surface shall be coated with the three-component coating system in the following sequence and manner. For immediate and final cure times and temperature, the recommendations of the coating manufacturer shall be followed.

a. Wash Primer. One coat of wash primer shall be applied by flooding.

b. Pigmented Base Coat. Pigmented baking phenolic coating shall be applied in several coats by immersion or flooding to a dry film thickness of 0.10 to 0.15 mm. 4 to 6 mils.

c. Clear Top Coat. Clear non-pigmented baking phenolic top coat shall be applied in several coats by immersion or flooding. The final coat may be applied by spraying. The dry film thickness of the total coating system shall be between 0.13 and 0.18 mm. 5 and 7 mils.

3.2.4 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 600 mm 2 feet before turning in an upward direction.

3.2.5 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be

made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. [Flushometer valves for water closets shall be installed 1 m 39 inches above the floor.] [Bumpers for water closet seats shall be installed on the [wall] [flushometer stop] [flushometer spud].]

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 775 mm 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 1020 mm 42 inches above floor. Wall-hung service sinks shall be mounted with rim 700 mm 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with CABO A117.1.

3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.5.2 Support for Cellular-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the cellular wall using through bolts and a back-up plate.

3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-

anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.5.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 6 mm (1/4 inch) 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.3.5.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with NAPHCC Plumbing Code at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METAL.

3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.3.10 Shower Pans

Before installing shower pan, subfloor shall be free of projections such as nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor.

3.3.10.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent practicable, allowing a minimum of 150 mm 6 inches for turnup on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

3.3.10.2 Metal Shower Pans

When a shower pan of required size cannot be furnished in one piece, metal pieces shall be joined with a flatlock seam and soldered or burned. The corners shall be folded, not cut, and the corner seam shall be soldered or burned. Pans, including upstands, shall be coated on all surfaces with one brush coat of asphalt. Asphalt shall be applied evenly at not less than 1 liter per square meter. 1 gallon per 50 square feet. A layer of felt covered with building paper shall be placed between shower pans and wood floors. The joining surfaces of metal pan and drain shall be given a brush coat of asphalt after the pan is connected to the drain.

3.3.10.3 Nonplasticized Chlorinated Polyethylene Shower Pans

Corners of nonplasticized chlorinated polyethylene shower pans shall be folded against the upstand by making a pig-ear fold. Hot-air gun or heat lamp shall be used in making corner folds. Each pig-ear corner fold shall be nailed or stapled 12 mm 1/2 inch from the upper edge to hold it in place. Nails shall be galvanized large-head roofing nails. On metal framing or studs, approved duct tape shall be used to secure pig-ear fold and membrane. Where no backing is provided between the studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding 12 mm 1/2 inch from upper edge. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Surfaces to be solvent-welded shall

be clean. Surfaces to be joined with xylene shall be initially sprayed and vigorously cleaned with a cotton cloth, followed by final coating of xylene and the joining of the surfaces by roller or equivalent means. If ambient or membrane temperatures are below 4 degrees C
40 degrees F the membrane and the joint shall be heated prior to application of xylene. Heat may be applied with hot-air gun or heat lamp, taking precautions not to scorch the membrane. Adequate ventilation and wearing of gloves are required when working with xylene. Membrane shall be pressed into position on the drain body, and shall be cut and fit to match so that membrane can be properly clamped and an effective gasket-type seal provided. On wood subflooring, two layers of 0.73 kg per square meter (15 pound) 15 pound dry felt shall be installed prior to installation of shower pan to ensure a smooth surface for installation.

3.3.10.4 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than 150 mm 6 inches in room areas and 75 mm 3 inches above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top 25 mm 1 inch of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it is to be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small amount of gravel or porous materials shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be clean (free of grease and grime). Sheets shall be laid on a flat surface with an overlap of about 50 mm. 2 inches. Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces immediately placed together, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. In long lengths, about 600 or 900 mm 2 or 3 feet at a time shall be welded. On wood subflooring, two layers of 0.73 kg per square meter (15 pound) 15 pound felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to

mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to [_____] percent of the lowest equipment rpm.

3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer.

3.4.2 Foundation-Mounted Compressors

[Foundation attachment shall be as recommended by the compressor manufacturer.] [Foundation shall be as recommended by the compressor manufacturer, except the foundation shall weigh not less than three times the weight of the moving parts.]

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm (1-3/8 inch) 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 12 mm 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 1 m 3 foot width, 750 mm 30 inches height, and 12 mm 1/2 inch thickness. The board shall be made of wood fiberboard and

framed under glass or 1.6 mm (1/16 inch) 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 20 mm (3/4 inch) 3/4 inch in diameter and the related lettering in 12 mm 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

Color	System	Item	Location
[_____]	[_____]	[_____]	[_____]

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTING, GENERAL.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with NAPHCC Plumbing Code.

a. Drainage and Vent Systems Tests.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address Model
Number	Certified Tester Serial
Number	Certified Tester No.

Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 25 mm 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.9.1.3 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 1.03 MPa 150 psig and hold this pressure for 2 hours with no drop in pressure.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. In general, sufficient water shall be used to produce a minimum water velocity of 0.762 meters per second (2.5 feet per second) 2.5 feet per second through piping being flushed. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.9.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the

Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. 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.

3.10 PLUMBING FIXTURE SCHEDULE

P-1 WATER CLOSET:

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, [floor mounted] [wall mounted]. Floor flange shall be copper alloy, cast iron, or plastic.

Gasket shall be wax type.

Seat - IAPMO Z124.5, Type A, [black] [white] [_____] plastic, elongated, open front.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 66.7 mm (2-5/8 inches) 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 6 liters 1.6 gallons per flush.

Flush Tank - An adequate quantity of water shall be provided to flush and clean the fixture served. The water supply to flush tanks equipped for manual flushing shall be controlled by a float valve or other automatic device designed to refill the tank after each discharge, and to completely shut off the water flow to the tank when the tank is filled to operational capacity. Water closets having their flush valve seat located below the flood level rim of the closet bowl shall have a ballcock installed within a sheath or in a separate and isolated compartment of the tank, both to have visible discharge onto the floor in case of failure. Provision shall be made to automatically supply water to the fixture so as to refill the trap seal after each flushing. The water supply to flush tanks equipped for automatic flushing shall be controlled by a suitable timing device. Ballcocks shall meet ASSE 1002.

Flush Valve in Flush Tank - Flush valve seats in tanks for flushing water closets shall be at least 25 mm (1 inch) 1 inch above the flood level rim of the bowl connected thereto, except in approved water closet and flush tank combinations designed so that when the tank is flushed and the fixture is clogged or partially clogged, the flush valve shall close tightly so that water will not spill continuously over the rim of the bowl or back flow from the bowl to the tank.

P-2 WATER CLOSET HANDICAPPED:

Height of top rim of bowl shall be in accordance with CABO A117.1; other features are the same as P-1.

P-3 URINAL:

[Wall hanging, with integral trap and extended shields, ASME A112.19.2M [siphon jet] [washout]. Top supply connection, back outlet.

Flushometer Valve - Similar to Flushometer Valve for P-1. The maximum water use shall be 3.8 liters 1 gallon per flush.]

[Wall hanging urinal shall be in accordance with IAPMO Z124.9 and be a waterless, non-flushing type, with replaceable trap insert having circular outer rim opening for flow. The replaceable trap insert shall contain a low specific gravity immiscible barrier liquid. The liquid shall be biodegradable. The urinal shall not require chair carrier. The urinal and trap assembly shall maintain a sufficient barrier of immiscible liquid necessary to inhibit backflow of sewer gases.]

P-4 BATHTUB:

Straight front, recessed, 1.524 m x 812.8 mm x 406.4 mm (60 x 32 x 16 in), 60 x 32 x 16 in, [enameled cast iron, ASME A112.19.1M raised bottom] [porcelain enameled formed steel with structural composite reinforcement ASME A112.19.4M. Structural reinforcement shall be in accordance with IAPMO Z124.1] including appendix [plastic, IAPMO Z124.1 without wall] [plastic, IAPMO Z124.1 with high wall].

Drain Assembly - Plug, cup strainer, overflow assembly, washers, couplings, pop-up lever, trip lever, stopper, fittings, etc., shall be brass, cast copper alloy, or wrought copper alloy. See paragraph FIXTURES for optional plastic accessories.

P-5 LAVATORY:

Manufacturer's standard sink depth, [enameled cast iron ASME A112.19.1M] [vitreous china ASME A112.19.2M], [straight back] [ledge back] [shelf back] [countertop, rectangular].

Faucet - Faucets shall be [single] [center set] [combination] [single control, mixing] type. [Faucets shall have replaceable seats and washers.] [Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools.] Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second 2.5 gpm at a flowing pressure of 549 kPa. 80 psi.

Handles - [Index turn] [Lever] [Four arm] [Crown] type. Cast, formed, or drop forged copper alloy.

Drain - [Strainer shall be copper alloy or stainless steel] [Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece]. See paragraph FIXTURES for optional plastic accessories.

P-6 WHEELCHAIR LAVATORY:

Vitreous china, ASME A112.19.2M, wheelchair lavatory with wrist or elbow controls 508.0 mm wide x 685.8 mm deep (20 inches wide x 27 inches deep) 20 inches wide x 27 inches deep with gooseneck spout. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second 2.5 gpm at a flowing water pressure of 549 kPa. 80 psi.

Drain - Strainer shall be copper alloy or stainless steel.

P-7 KITCHEN SINK:

Ledge back with holes for faucet and spout [single bowl [609.6 x 533.4 mm (24 x 21 inches) 24 x 21 inches] [609.6 x 762.0 mm (24 x 30 inches) 24 x 30 inches]] [double bowl [812.8 x 533.4 mm (32 x 21 inches) 32 x 21 inches] [1067.0 x 533.4 mm (42 x 21 inches) 42 x 21 inches]] [enameled cast iron ASME A112.19.1M] [porcelain enameled steel ASME A112.19.4M] [stainless steel ASME A112.19.3M].

Faucet and Spout - Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second 2.5 gpm at a flowing water pressure of 549 kPa. 80 psi.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

P-8 SERVICE SINK:

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.19.3M [trap standard 609.6 mm wide x 508.0 mm deep (24 inches wide x 20 inches deep), 24 inches wide x 20 inches deep, splashback 228.6 mm (9 inches) 9 inches high] [wall mounted 609.6 mm wide x 508.0 mm deep (24 inches wide x 20 inches deep), 24 inches wide x 20 inches deep, splashback 228.6 mm (9 inches) 9 inches high] [corner, floor mounted 711.2 mm (28 inches) 28 inches square, 171.5 mm (6-3/4 inches) 6-3/4 inches deep].

Faucet and Spout - Cast or wrought copper alloy, [with] [without] top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be [lever] [four arm] type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

Trap - Cast iron, minimum 7.5 cm 3 inch diameter.

P-9 COMBINATION SINK AND LAUNDRY TRAY:

[ledge back 1067 x 635.0 mm (42 x 25 inch, 42 x 25 inch), 101.6 mm (4 inch) 4 inch splash back, sink 203.2 mm (8 inches) 8 inches deep, tray 304.8 mm (12 inches) 12 inches deep)] [counter top 1067 x 533.4 mm (42 x 21 inch, 42 x 21 inch, 101.6 mm (4 inch) 4 inch splash back, sink 190.5 mm (7-1/2 inches) 7-1/2 inches deep, tray 254 mm (10 inches) 10 inches deep)], [left hand] [right hand], [enameled cast iron ASME A112.19.1M] [porcelain enameled steel ASME A112.19.4M].

Faucet and Spout - Cast or wrought copper alloy, [with] [without] top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads. Combination faucets with two valves and spouts shall be provided.

Handles - Cast or wrought copper alloy. [Indexed turn] [Lever] [Four arm] type.

P-10 LABORATORY SINK:

[ledge back [584.2 mm wide x 381.0 mm deep (23 inches wide x 15 inches deep) 23 inches wide x 15 inches deep] [762.0 mm wide x 508.0 mm deep (30 inches wide x 20 inches deep) 30 inches wide x 20 inches deep]] [countertop [508.0 mm wide x 381.0 mm deep (20 inches wide x 15 inches deep) 20 inches wide x 15 inches deep] [762.0 mm wide x 508.0 mm deep (30 inches wide x 20 inches deep) 30 inches wide x 20 inches deep]], [vitreous china ASME A112.19.2M] [acid-resistant enameled cast iron ASME A112.19.1M] [acid-resistant plastic IAPMO Z124.3] [corrosion-resisting steel ASME A112.19.3M]. Thickness of sinks shall be manufacturer's standard. [Drain] [drain and trap] shall be [stainless steel] [_____].

Faucet and Spout - Cast or wrought copper alloy, [with] [without] top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

P-11 SCULLERY SINK:

Stainless steel ASME A112.19.3M with drainboard, 914.4 x 609.6 mm (36 x 24 inch) 36 x 24 inch compartments, 685.8 mm (27 inch) 27 inch deep, 381.0 mm (15 inch) 15 inch splashback, [single compartment - 1549 mm (61 inches) 61 inches wide] [double compartment - 2743 mm (108 inches) 108 inches wide] [triple compartment - 3505.2 mm (138 inches) 138 inches wide]. Drain shall have quick opening valve. Support on stainless steel legs.

Faucet and Spout - Cast or wrought copper alloy, with backflow preventer.

Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads. Combination faucets with two valves and spouts shall be provided.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, four arm type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

P-12 LAUNDRY SINK:

Double bowl, [countertop 1067 x 533.4 mm (42 x 21 inches) 42 x 21 inches] [ledge back 1067 x 609.6 mm (42 x 24 inches) 42 x 24 inches)] [pedestal 1219 x 508.0 mm (48 x 20 inches) 48 x 20 inches] [leg support 1219 x 508.0 mm (48 x 20 inches), 48 x 20 inches,] [enameled cast iron ASME A112.19.1M] [stainless steel ASME A112.19.3M].

Faucet and Spout - Cast copper alloy, wrought copper alloy, cast iron, or stainless steel, with backflow preventer. Faucets shall have replaceable seat and the stem shall rotate onto the seat. Strainers shall have internal threads. Combination faucets shall be mounted on the tub back. Spouts shall be externally threaded for hose connection.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

Traps - Copper alloy, or cast iron.

P-13 Shower: Shower heads, CID A-A-240 other than emergency showers, shall be [adjustable] [nonadjustable] spray type and shall include a non-removable, tamperproof device to limit water flow to 0.16 liters per second (2.5 gpm) 2.5 gpm when tested in accordance with ASME A112.18.1M.

Wall Mounted: Shower head shall be [adjustable] [nonadjustable] spray, stainless steel or chromium plated brass with ball joint. Handles shall be [chrome-plated die cast zinc alloy] [manufacturer's option]. Control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be [thermostatic mixing] [pressure reducing] [mechanical mixing, single lever] [separate hot and cold water] type. Shower head shall be vandalproof with integral back.

Column Showers: Column showers shall have a 1.8 m (6 foot) 6 foot column height measured from floor to shower head, 12 mm 1/2 inch IPS threads.

Bath Showers: Bath showers shall include bathtub spout, shower head, valves, diverters. A shower head mounting [with ball joint] [without ball joint] [with ball joint and head integral with a formed wall plate] [with shower head integral with formed wall plate] shall be provided. Diverter shall be integral with single mixing valves or mounted hot and cold water valves. Tub spout shall be copper alloy.

Cabinet Showers: Free standing cabinet, single unit with receptor; 863.6 mm (34 inches) 34 inches wide by 863.6 mm (34 inches) 34 inches deep,

fiberglass reinforced plastic with terrazzo or plastic receptor. Cabinet shall include curtain rod, trim, and concealed fittings.

Emergency Showers: Head for Emergency and Emergency Eye and Face Wash. Shower control shall be 25 mm (1 inch) 1 inch or 40 mm (1-1/2 inch) 1-1/2 inch stay-open type control valve. Unit shall be [corrosion-resisting steel] [or] [enameled cast iron] and shall be [wall mounted] [pedestal mounted].

P-14 BUBBLER DRINKING FOUNTAINS:

Bubbler drinking fountains shall have self-closing valves. Self-closing valves shall have automatic stream regulators, flow control capability, a push button actuation or a cross-shaped index metal turn handle without a hood. Spouts shall provide a flow of water at least 100 mm (4 inches) 4 inches high so as to allow the insertion of a cup or glass under the flow of water. Stops, stream regulators, flow controls, pushbuttons, handles, and traps shall be made of copper zinc alloy. Strainers and drains shall be made of copper zinc alloy or stainless steel.

Surface Wall-Mounted - Surface wall-mounted units shall be 336.6 mm (13-1/4 inches) 13-1/4 inches wide, 330.2 mm (13 inches) 13 inches deep, 254.0 mm (10 inches) 10 inches high, and have a back height of 152.4 to 203.2 mm (6 to 8 inches). 6 to 8 inches. The bowl shall be made of corrosion-resisting steel. The unit shall have concealed fasteners and be for [interior] [exterior] installation.

Semi-Recessed Wall-Mounted - Semi-recessed wall-mounted units shall be 55.6 mm (14 inches) 14 inches wide, 279.4 mm (11 inches) 11 inches deep, 676.3 mm (26-5/8 inches) 26-5/8 inches high, and have a back height of 330.2 to 558.8 mm (13 to 22 inches). 13 to 22 inches. The bowl shall be made of corrosion-resisting steel. The unit shall be for [interior] [exterior] installation.

Recessed Wall-Mounted - Recessed wall-mounted units shall be 425.5 mm 16-3/4 inches) 16-3/4 inches wide, 279.4 mm (11 inches) 11 inches deep, 762.0 mm (30 inches) 30 inches high, and have a back height of 330.2 to 558.8 mm (13 to 22 inches). 13 to 22 inches. The bowl shall be made of corrosion-resisting steel. The unit shall be for [interior] [exterior] installation.

Handicapped - Handicapped units shall be surface wall-mounted. The dimensions shall be 381.0 mm (15 inches) 15 inches wide, 508.0 mm (20 inches) 20 inches deep, with a back height of 152.4 to 203.2 mm (6 to 8 inches). 6 to 8 inches. The unit shall clear the floor or ground by at least 200 mm (8 inches). 8 inches. A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 685 mm (27 inches) 27 inches and between the front edge of the bowl and the body of the unit of at least 200 mm (8 inches). 8 inches. A 200 mm (8 inch) 8 inch wide clear space shall exist on both sides of the unit. The spout height shall be no more than 915 mm (36 inches) 36 inches above the floor or ground to the outlet. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The bowl shall be 165.1 mm (6-1/2 inches) 6-1/2

inches high and made of corrosion-resisting steel. The unit shall be for [interior] [exterior] installation.

Interior Free Standing - Free standing units shall be 1016 to 1054.1 mm (40 to 41-1/2 inches) 40 to 41-1/2 inches high, 304.8 to 457.2 mm (12 to 18 inches) 12 to 18 inches wide, and 304.8 to 355.6 mm (12 to 14 inches) 12 to 14 inches deep. The bowl shall be made of corrosion-resisting steel. The unit shall be for interior installation.

Exterior Free Standing - Free standing units shall be 914.4 mm (36 inches) 36 inches high, and 304.8 to 457.2 mm (12 to 18 inches) 12 to 18 inches in diameter. The bowl shall be made of stainless steel. The unit shall be for exterior installation.

P-15 WATER COOLER DRINKING FOUNTAINS:

Water cooler drinking fountains shall: be self contained, conform to ARI 1010, use one of the fluorocarbon gases conforming to ARI 700 and ASHRAE 34 which has an Ozone Depletion Potential of less than or equal to 0.05, have a capacity to deliver 30.2 liters per hour (8 gph) 8 gph of water at 10 degrees C (50 degrees F) 50 degrees F with an inlet water temperature of 27 degrees C (80 degrees F) 80 degrees F while residing in a room environment of 32 degrees C (90 degrees F), 90 degrees F, and have self-closing valves. Self-closing valves shall have automatic stream regulators, have a flow control capability, have a push button actuation or have a cross-shaped index metal turn handle without a hood. Exposed surfaces of stainless steel shall have No. 4 general polish finish. Spouts shall provide a flow of water at least 100 mm (4 inches) 4 inches high so as to allow the insertion of a cup or glass under the flow of water.

Surface Wall-Mounted - Surface wall-mounted units shall be 336.6 mm (13-1/4 inches) 13-1/4 inches wide, 330.2 mm (13 inches) 13 inches deep, and have a back height of 152.4 to 203.2 mm (6 to 8 inches). 6 to 8 inches. The bowl shall be made of stainless steel. The unit shall have concealed fasteners and be for [interior] [exterior] installation.

Semi-Recessed Wall-Mounted - Semi-recessed wall-mounted units shall be 355.6 mm (14 inches) 14 inches wide, 279.4 mm (11 inches) 11 inches deep, and have a back height of 330.2 to 558.8 mm (13 to 22 inches). 13 to 22 inches. The bowl shall be made of stainless steel and be for [interior] [exterior] installation.

Recessed Wall-Mounted - Recessed wall-mounted units shall be 425.5 mm (16-3/4 inches) 16-3/4 inches wide, 279.4 mm (11 inches) 11 inches deep, and have a back height 330.2 to 558.8 mm (13 to 22 inches). 13 to 22 inches. The bowl shall be made of stainless steel and be for [interior] [exterior] installation.

Handicapped - Handicapped units shall be surface wall-mounted. The dimensions shall be 381.0 mm (15 inches) 15 inches wide, 508.0 mm (20 inches) 20 inches deep, with a back height of 152.4 to 203.2 mm (6 to 8 inches). 6 to 8 inches. The unit shall clear the floor or ground by at least 200 mm (8 inches). 8 inches. A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 685 mm (27

inches) 27 inches and between the front edge of the bowl and the body of the unit of at least 200 mm (8 inches). 8 inches. A 200 mm (8 inch) 8 inch wide clear space shall exist on both sides of the unit. The spout height shall be no more than 1 m (36 inches) 36 inches above the floor or ground to the outlet. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The bowl shall be 165.1 mm (6-1/2 inches) 6-1/2 inches high, made of stainless steel and be for [interior] [exterior] installation.

Interior Free Standing - Free standing units shall be 1016 to 1054.1 mm (40 to 41-1/2 inches) 40 to 41-1/2 inches high, 304.8 to 457.2 mm (12 to 18 inches) 12 to 18 inches wide, and 304.8 to 355.6 mm (12 to 14 inches) 12 to 14 inches deep. The bowl shall be made of stainless steel and be for interior installation.

P-16 FOOD WASTE DISPOSER:

Food waste disposers shall be in accordance with UL 430.

P-17 GARBAGE DISPOSAL MACHINES:

Garbage disposals machines shall be in accordance with CID A-A-50012.

P-18 WASH FOUNTAIN:

[Circular - 6 or 8 station] [Semicircular - 3, 4, 5 station] [Corner, 2 or 3 station], [1.9837 mm (14 gauge) 14 gauge stainless steel] [galvanized steel] [masonry] bowl.

P-19 DISHWASHING MACHINES:

[Commercial dishwashing machines shall conform to NSF 3, NSF 5 and UL 921.] [Household dishwashing machines shall conform to UL 749 and ASSE 1006, sized as indicated.]

3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 21 degrees C 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = o (trace is permitted).

SL = Standby loss in W/0.093 sq. m. W/sq. ft. based on 27 degrees C 80 degrees F delta T, or in percent per hour based on nominal 38 degrees C 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

3.12.1 Storage Water Heaters

3.12.1.1 Electric

a. Storage capacity of 454 liters 120 gallons or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.

b. Storage capacity of more than 454 liters 120 gallons or input rating more than 12 kW: maximum SL shall be 1.9 w/0.093 sq. m.
1.9 W/sq. ft. per ASHRAE 90.1, Addenda B.

3.12.1.2 Gas

a. Storage capacity of 379 liters 100 gallons or less, and input rating of 21980 W 75,000 Btu/h or less: minimum EF shall be 0.62-0.0019V per 10 CFR 430.

b. Storage capacity of more than 379 liters 100 gallons - or input rating more than 21980 W: 75,000 Btu/h: Et shall be 77 percent; maximum SL shall be 1.3+38/V, per ANSI Z21.10.3.

3.12.1.3 Oil

a. Storage capacity of 189 liters 50 gallons or less and input rating of 30773 W 105,000 Btu/h or less: minimum EF shall be 0.59-0.0019V per 10 CFR 430.

b. Storage capacity of more than 189 liters 50 gallons or input rating more than 30773 W: 105,000 Btu/h: EC shall be 83 percent; maximum SL shall be 1.3+38/V, per 10 CFR 430.

3.12.2 Unfired Hot Water Storage

Volumes and inputs: maximum HL shall be 20.5 W/sq. meter. 6.5 Btu/h/sq. ft.

3.12.3 Instantaneous Water Heater

3.12.3.1 Gas

Volumes and inputs: ET shall be 80 percent per ANSI Z21.10.3.

3.12.3.2 Oil

Capacities and inputs: EC shall be 83 percent per ANSI Z21.10.3.

3.12.4 Pool Heaters

Gas/oil fuel, capacities and inputs: ET shall be 78 percent per ANSI Z21.56.

3.13 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	X	
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888		X	X	X		
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X	
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47/A 47M	X	X		X	X	
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M for use with Item 5	X	X		X	X	
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5	X	X		X	X	
8	Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B 75M ASTM B 75 C12200, ASTM B 152, ASTM B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X	pressure			
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X	
10	Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B	X			X	X	
11	Seamless red brass pipe, ASTM B 43		X	X			
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X	

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	B	C	D	E	F
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X	
14	Seamless copper pipe, ASTM B 42				X		
15	Cast bronze threaded fittings, ASME B16.15				X	X	
16	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X	
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	
19	Acrylonitrile-Butadiene-Styrene (ABS) X plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628	X	X	X	X	X	
20	Polyvinyl Chloride plastic drain, X waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40) ASTM F 1760	X	X	X	X	X	
21	Process glass pipe and fittings, X ASTM C 1053						
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518/A 518M			X		X	
23	Polypropylene (PP) waste pipe and X fittings, ASTM D 4101						
24	Filament-wound reinforced thermosetting X resin (RTRP) pipe, ASTM D 2996						

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent

TABLE I

PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F

E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
* - Hard Temper

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE A	B	C	D
1	Malleable-iron threaded fittings,	X	X	X	X
a.	Galvanized, ASME B16.3 for use with Item 4a				
b.	Same as "a" but not galvanized X for use with Item 4b				
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47/A 47M, non-ferrous pipe, ASTM A 536 and ASTM A 47/A 47M,	X	X	X	
3	Ductile iron grooved joint fittings ferrous pipe ASTM A 536 and ASTM A 47/A 47M, for use with Item 2	X	X	X	for
4	Steel pipe:	X	X	X	X
a.	Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B				
b.	Seamless, black, X ASTM A 53/A 53M, Type S, Grade B				
5	Seamless red brass pipe, ASTM B 43	X	X		X
6	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
7	Seamless copper pipe, ASTM B 42	X	X		X
8	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**	X***
9	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X
10	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5 and 7	X	X	X	X
11	Cast copper alloy solder-joint pressure fittings, ASME B16.18	X	X	X	X

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE A	B	C	D
	for use with Items 8 and 9				
12	Bronze and sand castings grooved pressure fittings for non ferrous pipe ASTM B 584, Item 2	X	X	X	joint for use with
13	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447	X			X
14	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035	X			X
15	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239	X			X
16	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 14, 15, and 16	X			X
17	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 15	X			X
18	Polyethylene (PE) plastic tubing, ASTM D 2737	X			X
19	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846/D 2846M	X	X		X
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441/F 441M	X	X		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442/F 442M	X	X		X
22	Threaded chlorinated polyvinyl chloride	X	X		X

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE A	B	C	D
	(chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F 437, for use with Items 20, and 21				
23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 20, 21, and 22	X	X	X	
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 20, 21, and 22	X	X		X
25	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X			X
26	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X			X
27	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X			X
28	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467 for use with Items 26 and 27	X			X
29	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464	X			X
30	Joints for IPS pvs pipe using solvent cement, ASTM D 2672	X			X
31	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996	X	X		
32	Steel pipeline flanges,	X	X	MSS SP-44	
33	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X		
34	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
35	Malleable-iron threaded pipe B16.39	X	X	unions	ASME
36	Nipples, pipe threaded 733	X	X	X	ASTM A

A - Cold Water Aboveground
B - Hot Water 82 degree C 180 degrees F Maximum Aboveground
C - Compressed Air Lubricated
D - Cold Water Service Belowground
Indicated types are minimum wall thicknesses.
** - Type L - Hard
*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors
**** - In or under slab floors only brazed joints

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY LITERS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Elect.	454 max.	12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	454 min.	OR 12 kW min.	ASHRAE 90.1 (Addenda B)	SL = 1.9 W/0.09 sq. m. maximum
Gas	380 max.	22 kW max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	380 min.	OR 22 kW min.	ANSI Z21.10.3	ET= 77 percent; SL = 1.3+38/V max.
Oil	190 max.	30.8 kW	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	190 min.	OR 30.8 kW	10 CFR 430	EC = 83 percent; SL = 1.3+38/V maximum

B. Unfired Hot Water Storage, Instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 20.5 W/sq. meter

C. Instantaneous Water Heater

Gas	All	All	ANSI Z21.10.3	ET = 80 percent
Oil	All	All	ANSI Z21.10.3	EC = 83 percent

D. Pool Heater

Gas or Oil	All	All	ANSI Z21.56	ET = 78 percent

TERMS:

EF = Energy factor, overall efficiency.
ET = Thermal efficiency with 21 degrees C delta T.
EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/0.09 sq. m. based on 27 degrees C delta T, or in percent per hour based on nominal 32 degrees C delta T.
HL = Heat loss of tank surface area
V = Storage volume in gallons

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Elect.	120 max.	12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	120 min. OR	12 kW min.	ASHRAE 90.1 (Addenda B)	SL = 1.9 W/sq. ft. maximum
Gas	100 max.	75,000 Btu/h max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	100 min. OR	75,000 Btu/h	ANSI Z21.10.3	ET = 77 percent; SL = 1.3+38/V max.
Oil	50 max.	105,000 Btu/h	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	51 min. OR	105,000 Btu/h	10 CFR 430	EC = 83 percent; SL = 1.3+38/V

maximum B. Unfired Hot Water Storage, instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

C. Instantaneous Water Heater

Gas	All	All	ANSI Z21.10.3	ET = 80 percent
Oil	All	All	ANSI Z21.10.3	EC = 83 percent

D. Pool Heater

Gas or Oil	All	All	ANSI Z21.56	ET = 78 percent

TERMS:

EF = Energy factor, overall efficiency.
ET = Thermal efficiency with 70 degrees F delta T.
EC = Combustion efficiency, 100 percent - flue loss when smoke = 0

(trace is permitted).
SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.
HL = Heat loss of tank surface area
V = Storage volume in gallons

-- End of Section --

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SECTION 16375

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

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 in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

UDERWRITERS LABORATORIES (UL)

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall [conform to Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT] [be as indicated].

a. Fungus Control [_____]

b. Altitude [_____] m feet

c. Ambient Temperature [_____] degrees C degrees F

d. Frequency [_____]

e. Ventilation [_____]

f. Seismic Parameters [_____]

g. Humidity Control [_____]

h. Corrosive Areas [_____]

i. [_____]

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Electrical Distribution System; [_____], [_____]

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project.

Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

a. Medium-voltage cables and accessories including cable installation plan.

b. Transformers.

c. Substations.

d. Switchgear.

e. Pad-mounted loadbreak switches.

f. Busways.

g. Surge arresters.

As-Built Drawings; [_____], [_____]

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the

work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

SD-03 Product Data

Fault Current and Protective Devices Coordination Studies; G, [_____]

The study shall be submitted with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog Data; [_____], [_____]

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; [_____], [_____]

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Procedures; [_____], [_____]

As a minimum, installation procedures for transformers, substations, switchgear, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Factory Tests; [_____], [_____]

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days

following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing; [_____], [_____]

A proposed field test plan, [20] [30] [_____] days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Test Reports; [_____], [_____]

[Six] [_____] copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Cable Installation Reports; [_____], [_____]

[Six] [_____] copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Materials and Equipment; [_____], [_____]

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Splicer Qualification; [_____], [_____]

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's

instruction for the proper splicing and termination of the approved cable types.

Cable Installer Qualifications; [_____], [_____]

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-10 Operation and Maintenance Data

Electrical Distribution System; [_____], [_____]

[Six] [_____] copies of operation and maintenance manuals, within [7] [_____] calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 25 mm 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE ANSI/IEEE C57.12.00. Nameplates shall indicate the number of liters gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than [50] [2] ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the [50] [2] ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

[Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.] [Aluminum shall not be used.]

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand [120] [480] [_____] hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting

of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be [Type MV, conforming to NFPA 70 and UL 1072] [concentric neutral underground distribution cable conforming to AEIC CS5 and NEMA WC 7] [metallic armored cables, consisting of three-conductor, multi-conductor cables, with insulation and shielding, as specified, using [a galvanized steel] [an aluminum] interlocked tape armor and thermoplastic jacket]. Cables shall be manufactured for use in [duct] [or] [direct burial] applications [as indicated].

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage [of] [5 kV] [15 kV] [25 kV] [28 kV] [35 kV] [as indicated].

2.4.1.3 Conductor Material

Underground cables shall be [soft drawn copper complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding] [aluminum alloy 1350, 3/4 hard minimum complying with ASTM B 609, ASTM B 609M and ASTM B 231 for regular concentric and compressed stranding or ASTM B 400 for compacted stranding].

2.4.1.4 Insulation

Cable insulation shall be [cross-linked thermosetting polyethylene (XLP) insulation conforming to the requirements of NEMA WC 7 and AEIC CS5] [ethylene-propylene-rubber (EPR) insulation conforming to the requirements of NEMA WC 8 and AEIC CS6] [_____]. A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper [tape] [wire] shield for each phase. The shield [tape] [wire] shall be sized to meet IEEE C2 requirements for a ground fault availability of [_____] amperes.

2.4.1.6 Neutrals

[Neutral conductors of shall be [copper] [aluminum]. employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.] [Concentric neutrals conductors shall be tinned copper, having a combined ampacity [equal to] [1/3 of] the phase conductor ampacity rating.]

2.4.1.7 Jackets

Cables shall be provided with a [PVC] [polyethylene] [_____] jacket. Direct buried cables shall be rated for direct burial.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be [annealed copper complying with ASTM B 3 and ASTM B 8] [Type AA-8000 aluminum conductors complying with ASTM B 800 and ASTM B 801]. Intermixing of copper and aluminum conductors is not permitted.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Jackets

Multiconductor cables shall have an overall [PVC] [_____] outer jacket.

2.4.2.4 Direct Buried

Single and multi-conductor cables shall of a type identified for direct burial. Service entrance cables shall conform to UL 854 for Type USE service entrance cable.

2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70. [Cables in factory-installed, coilable-plastic-duct assemblies shall conform to NEMA TC 5 or NEMA TC 7].

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to

the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. [Leakage distances shall comply with wet withstand voltage test requirements of IEEE Std 48 for the next higher Basic Insulation Level (BIL) level.] [Anti-tracking tape shall be applied over exposed insulation of preformed molded elastomer terminations].

2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least [315][510][635][890 mm][1.2 m] [12-1/2] [20][25][35][46] inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

[Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application.] [Duct lines shall be concrete-encased, thin-wall type.] [Duct lines shall be nonencased direct-burial, thick-wall type.] [Duct lines shall be concrete-encased, thin-wall type for duct lines between manholes and for other medium-voltage lines.] [[Low-voltage lines] [or] [Communication lines] run elsewhere may be direct-burial,

thick-wall type.] [Where concrete encasement is not required, low-voltage circuits may utilize factory-installed cable in coilable plastic duct.]

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Bituminized Fiber Duct

UL 1684 for [Type I (Thinwall)][Type II (Thickwall)].

2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

2.6.2.3 Direct Burial

UL 651 [Schedule 40][and][Schedule 80][as indicated], or NEMA TC 6 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C (35 degrees F), 35 degrees F, shall neither slump at a temperature of 150 degrees C (300 degrees F), 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least [69 MPa (10,000 psi)][_____] MPa ([_____] psi) [10,000] [_____] psi and a flexural strength of at least [34.5 MPa (5000 psi)][_____] MPa ([_____] psi).[5,000] [_____] psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 POLES AND HARDWARE

Poles and hardware shall be in accordance with Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

2.9 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be [5] [15] [25] [28] [35] kV between phases for 133 percent insulation level.

2.9.1 Secondary Unit Substation

Secondary unit substations shall comply with ANSI C37.121 and shall be of the [radial type] [radial type with an outgoing section mounted integrally on the transformer] [secondary-selective type] [distributed-network type] [spot-network type]. Substations shall be subassembled and coordinated by one manufacturer and shall be shipped in complete sections ready for connection at the site. Complete sections shall include incoming, transformer, and outgoing sections and, where practicable, shall be shipped as one unit.

2.9.1.1 Incoming Section

Metal-enclosed interrupter switchgear consisting of fused, [air-insulated] [vacuum-insulated] [SF6-insulated], interrupters in series with automatic, visible blade disconnects shall be provided for protection of incoming circuits. [SF6 gas shall conform to ASTM D 2472]. Metal-enclosed interrupter switchgear shall comply with IEEE ANSI/IEEE C37.30 for load-interrupter switches, NEMA SG 2 for power fuses, and shall be of the outdoor no-aisle type that meets or exceeds the requirements of applicable publications listed. Switch construction shall be of the manually-operated, "OPEN-CLOSED,"
[air-insulated][vacuum-insulated][SF6-insulated], load interrupter type equipped with a stored energy operator for quick-make quick-break to make operating speeds independent of manual switch operations. Where indicated, suitable bus or lug connections shall be provided to mount field-installed, slip-on, medium-voltage cable terminations for cable entering via conduit from below [and a flanged throat suitable for direct connection to the associated transformer] [and a bus throat suitable for connection to the associated metal-enclosed bus]. [Surge protection shall be provided in accordance with paragraph SURGE ARRESTERS.] [Switches shall be of the 2-position type, open-closed.] [Selector switches shall be of the single-compartment, 3-position type, Line 1 - Open - Line 2, consisting of an interrupter switch in series with a selector switch.] [Duplex switches shall be of the dual compartment type with 2 interrupter switches.]

a. Ratings. Fuse continuous current ratings shall be as indicated for the transformer for an incoming line unit and for the line tie unit. Unless otherwise indicated, fuses shall be of the current limiting type. Switch ratings at 60 Hz shall be:

Nominal
voltage. .....[_____].

Rated maximum
voltage. .....[_____].

Maximum symmetrical interrupting
capacity. .....[_____].

Maximum asymmetrical interrupting
capacity. .....[_____].

3-Second short time current carrying
capacity. .....[_____].

Rated continuous
current. .....[_____].

BIL. .....[_____]
.

b. Basic Requirements. The electrical devices listed below shall be rated for the application and voltage and current indicated. Unless otherwise noted, manufacturer's standard devices shall be provided and shall include the following:

(1) A switch-operating handle with provisions for locking in either the open or closed position.

(2) A switch mechanical position indicator.

(3) A heater continuously energized to prevent condensation over an ambient temperature range of [minus 29 degrees C (minus 20 degrees F)][minus [_____] degrees C (minus [_____] degrees F)] to [40 degrees C (104 degrees F)][[_____] degrees C ([_____] degrees
F)] [minus [20][_____] degrees F] to [[40][_____] degrees F] at 90% relative humidity and wired in series with a cabinet door-actuated switch, so the heater is de-energized when doors are open. High-temperature thermal protection shall be included.

(4) One-pole or 2-pole thermal-magnetic, molded-case circuit breakers suitable for the operating voltage for heater circuits.

(5) Safety devices as necessary to ensure that the load interrupter switch is in the open position whenever unit doors are in the open position.

(6) A key interlock if indicated.

(7) An interface terminal block wired for required exterior connections.

2.9.1.2 Transformer Section

Transformers shall have two separate windings per phase and shall be of the [mineral oil-insulated] [less-flammable, liquid-insulated] type with [high molecular-weight hydrocarbon] [or] [dimethyl silicone] liquid. Transformers shall be suitable for outdoor use. Liquid-insulated transformers shall comply with IEEE ANSI/IEEE C57.12.00, ANSI C57.12.13, and ANSI C57.12.27, and shall have two 2-1/2 percent full capacity taps above and two 2-1/2 percent full capacity taps below rated voltage. Transformers shall be of the sealed tank type construction with welded-on cover. High-voltage terminals shall be provided [in an air terminal chamber for incoming [top] [bottom] entry cables][for direct connection to the incoming line section] [as shown on the drawings]. Low-voltage terminals shall be provided [in an air terminal chamber for incoming [top] [bottom] entry cables] [for direct connection to the outgoing [switchgear section] [bus duct]] [as shown on the drawings]. Low-voltage terminals shall be [on the [left] [right]] [as shown on the drawings] when facing the front, accessory side of the transformer. [Transformers shall be equipped with forced air cooling equipment to give [_____] kVA capacity. The equipment shall include the necessary fans, conduit and wiring, motor starters, and top liquid thermometer for fan control.] [Provision shall be made for the future addition of forced air cooling equipment to give [_____] kVA capacity. The transformer bushings, leads, and other components shall be designed to carry the increased load. A top liquid thermometer for control of future fans shall be furnished. Provision for future mounting of fans, conduit, and terminal box shall be provided.] Transformer accessories and ratings at 60 Hz shall be as follows: Three-phase capacity, self-cooled.....[_____] kVA.

Three-phase capacity, (future) forced-cooled.....[___] kVA.

Impedance..[5.75 percent, standard] [[___] percent nonstandard].

Temperature rise.....[65 degrees C] [55/65 degrees C].

High-voltage winding.....[_____] volts.

High-voltage winding connection.....[_____].

Low-voltage winding.....[_____] volts.

Low-voltage winding connection.....[_____].

Accessories:

a. drain and filter connection.

b. filling and top filter press connection.

c. pressure-vacuum gauge.

d. dial type thermometer with alarm contacts.

e. magnetic liquid level indicator with high and low level alarm contacts.

f. pressure relief device with alarm contacts.

g. ground connection pad.

h. provision for jacking, lifting, and towing.

i. diagram and rating nameplate.

2.9.1.3 Integral Outgoing Section

Integral outgoing section shall be of the [busway throat compartment] [dead-front distribution panelboard/switchboard] [metal-enclosed switchgear] type. Each circuit breaker and auxiliary compartment shall have a suitable metal or laminated plastic nameplate with white cut letters at least 6.4 mm (1/4 inch) 1/4 inch high on contrasting backgrounds [identifying the breaker unit and/or circuit number] [as shown on the drawings].

a. Busway Throat Compartment Type: Outgoing section shall consist of an enclosure containing metering devices on the main secondary circuit and connections from transformer terminals to suitable busway throats provided for connections to busway installations entering [from above] [as shown]. Connection to porcelain bushings shall be made with flexible jumpers.

b. Dead-Front Distribution Panelboard/Switchboard Type: Outgoing section shall be of the panelboard/switchboard type mounted integrally with the transformer and shall consist of metering devices and main and branch circuit breakers mounted in panelboard/switchboard enclosures. Panelboards shall comply with NEMA PB 1. Switchboards shall comply with NEMA PB 2. Molded-case and low-voltage power circuit breakers shall comply with paragraph METERING AND PROTECTIVE DEVICES. Plug-in type circuit breakers are not acceptable. Directories to indicate loads served by each circuit shall be typed and mounted in holders provided on panelboard doors behind protective coverings.

c. Metal-Enclosed Switchgear Type: [Outgoing section shall be of the metal-enclosed drawout circuit breaker type, in accordance with IEEE ANSI/IEEE C37.20.1 and NEMA SG 5.] Low-voltage power circuit breakers shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES.

d. Metering: The main secondary bus of each outgoing section assembly shall include a watthour demand meter with the necessary instrument transformers, and VT and CT test blocks. Metering shall be as specified in paragraph METERING AND PROTECTIVE DEVICES.

e. Ground Fault Protection: Ground fault protection shall be provided utilizing sensors of the zero-sequence type or by the residual connection of phase and neutral current sensors. Ground fault settings shall be [as shown] [as determined by the coordination study].

2.9.1.4 Nonintegral (Cable Compartment) Outgoing Section

A cable compartment shall be provided on the transformer for cable connections as shown. Clamp type terminations for cables entering from [below] [above] shall be provided for connection to the transformer bushings. Clamp type cable terminations, suitable for [copper] [aluminum] conductors, shall be provided [for the circuit sizes shown] [to match circuit breakers].

2.9.2 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the [radial] [loop feed] type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.9.2.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, [drawout, dry-well-mounted, current-limiting fuses] [oil-immersed, current-limiting, bayonet-type fuses] [oil-immersed, bayonet-type, overload fuse in series with a partial range current-limiting fuse], medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stencilled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on [the same bushing as the primary cable by means of a loadbreak, feed-through bushing insert] [a second set of high voltage bushings].

2.9.2.2 Load-Break Switch

[Radial-feed oil-immersed type rated at [15] [_____] kV, [95] [_____] kV BIL, with a continuous current rating and load-break rating of [200] [_____] ampere, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.]

[Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch shall be rated at [15] [_____] kV, [95] [_____] kV BIL, with a continuous current rating and load-break rating of [200] [_____] amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.] Operation of switches shall be as follows:

ARRANGEMENT #	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION LINE A SW OPEN	LINE A SW CLOSE	LINE B SW OPEN	LINE B SW CLOSE	XFMR SW OPEN	XFMR SW CLOSE
1	Line A connected to Line B and both lines connected to transformer		X		X		X
2	Transformer connected to Line A only		X	X			X
3	Transformer connected to Line B only	X			X		X
4	Transformer open and loop closed		X		X	X	
5	Transformer open and loop open	X		X		X	

2.9.2.3 Transformer Tank Sections

Transformers shall comply with IEEE ANSI/IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.26 and shall be of the [mineral oil-insulated type] [less-flammable, liquid-insulated type with [high molecular-weight hydrocarbon] [or] [dimethyl silicone] liquid]. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided [2 above and 2 below] [below] rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be

provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity.....[_____] kVA.

Impedance. ..... [_____].

Temperature Rise.....65 degrees C.

High-voltage winding.....[_____] volts.

High-voltage winding connections. ..... [_____].

Low-voltage winding.....[_____] volts.

Low-voltage winding connections. ..... [_____]

2.9.2.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for [copper] [aluminum] conductors entering from below, shall be provided as necessary.

2.9.2.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.9.3 Busways

Busways shall comply with NEMA BU 1 and UL 857 and shall be of the voltage, phase, and continuous current ratings indicated. Neutrals shall be [full size] [half size]. Busways shall have short-circuit ratings not less than the maximum short-circuit currents of associated transformers, assuming primary sources of infinite capacity. Busways shall be feeder-low-impedance type and of outdoor or indoor service construction as suitable to the location. Busways shall be complete with elbows, fittings, flanges, end-closures, tees, crosses, cable-tap boxes, accessories, and other devices required for the indicated installation, and shall be coordinated for connection to the indicated equipment. For wet/damp locations, bus duct shall be heated, nonventilated enclosure, nonsegregated phase type in accordance with IEEE ANSI/IEEE C37.23. Detail drawings for busway supports and bracing shall be submitted in accordance with the detail drawings portion of paragraph SUBMITTALS and shall indicate that busways are adequately supported for the seismic forces specified in paragraph GENERAL REQUIREMENTS (sub-paragraph Service Conditions).

2.9.4 Pad-Mounted, Metal-Enclosed, Switchgear

The switchgear shall be configured with [[2] [_____] incoming compartments for loop-feed arrangement] [one incoming compartment for radial-feed], equipped with [air-insulated, load-interrupter switches] [oil-insulated, load-interrupter switches] [SF6-insulated, load-interrupter switches], as indicated. The outgoing compartments shall be provided with [fused disconnects] [non-reclosing vacuum-type interrupters or circuit breakers], as indicated.

2.9.4.1 Ratings at 60 Hz shall be:

Nominal voltage (kV). ..... [_____].

Rated maximum voltage (kV). ..... [_____].

Rated continuous current (A). ..... [_____].

Maximum symmetrical interrupting capacity (kA). ..... [_____].

Maximum asymmetrical interrupting capacity (kA). ..... [_____].

Three-second short-time current-carrying capacity (kA). .... [_____].

BIL (kV). ..... [_____].

2.9.4.2 Operators, Devices, and Controls

Operators and controls shall be provided for the switchgear as follows:

a. Switches shall be provided with a manual, handle-type operator or a push-button mechanical spring tripping mechanism, utilizing a stored-energy (spring-driven) mechanism to simultaneously open or close all phases. The switchgear shall be configured so that the switch actuator is padlockable, but may be accessed without opening the switch compartment doors.

b. Fused disconnects shall be hook-stick operated.

c. Switches shall be provided with an automatic switch operator configured for local and remote opening and closing. An actuator charging motor shall be provide which operates at [12 V dc], [24 V dc] [120 V ac]. Switches shall be provided with remote telemetry units (RTUs) for remote operation and integration with supervisory, control, and data acquisition systems. Systems, components, and equipment shall conform to the requirements and recommendations of IEEE ANSI/IEEE C37.1.

d. Vacuum type interrupters shall be provided with an electronic controller for trip initiation. Manual trip initiation shall be provided by a push button or switch. Automatic trip shall be initiated by detection of excessive current. The electronic controller shall provide trip current selection capability according to present time-current response curves, as indicated.

Each interrupter shall be provided with a 3 phase, gang-operated handle mechanism for trip and reset.

2.9.4.3 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of ANSI C57.12.28, ANSI C37.72, and IEEE ANSI/IEEE C37.20.3, Category A.

2.9.5 Pad-Mounted Sectionalizers

Pad-mounted, sectionalizing switches shall conform to the requirements of IEEE ANSI/IEEE C37.63. The switchgear shall be configured with [[2] [_____] incoming compartments for loop-feed arrangement] [one incoming compartment for radial-feed] equipped with [air-insulated, load-interrupter switches] [oil-insulated, load-interrupters switches] [SF6-insulated load-interrupter switches], as indicated. The outgoing compartments shall be provided with non-reclosing sectionalizers.

2.9.5.1 Ratings

Ratings at 60 Hz shall be:

Nominal voltage (kV). ..... [_____].

Rated maximum voltage (kV). ..... [_____].

Rated continuous current (A). ..... [_____].

Three-second short-time current-carrying capacity (kA). ..... [_____].

BIL (kV). ..... [_____].

2.9.5.2 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of ANSI C57.12.28, ANSI C37.72, and IEEE ANSI/IEEE C37.20.3, Category A.

2.9.6 Cable Terminating Cabinets

Cable terminating cabinets shall be hook-stick operable, deadfront construction conforming to the requirements of IEEE ANSI/IEEE C37.20.3, Category A. Cabinets shall be provided with [with 200 A. loadbreak junctions and elbow-type separable loadbreak connectors, cable parking stands, and grounding lugs] [with 600 A. dead-break junctions and elbow-type separable dead-break connectors, cable parking stands, and grounding lugs]. The cable terminating equipments shall conform to IEEE Std 386.

Ratings at 60 Hz shall be:

Nominal voltage (kV). ..... [_____].

Rated maximum voltage (kV). ..... [_____].

Rated continuous current (A). ..... [_____].

Three-second short-time current-carrying capacity (kA). ..... [_____].

BIL (kV). ..... [_____].

2.10 METERING AND PROTECTIVE DEVICES

2.10.1 Circuit Breakers, Low-Voltage

2.10.1.1 Low-Voltage Power Circuit Breakers

a. Construction

Low-voltage power circuit breakers shall conform to IEEE ANSI/IEEE C37.13, ANSI C37.16, and NEMA SG 3 and shall be three-pole, single-throw, stored energy, [manually] [electrically] operated, with drawout mounting. Solid-state trip elements which require no external power connections shall be provided. Circuit breakers shall have an open/close contact indicator, primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of primary disconnections when the circuit breaker is closed. Control voltage shall be [[24] [48] [125] V dc] [120 V ac] [as indicated]. The circuit breaker enclosure shall be suitable for its intended location.

b. Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings shall be in accordance with ANSI C37.16. Tripping features shall be as follows:

(1) Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

(2) Adjustable long-time delay.

(3) Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

(4) Adjustable short-time delay.

(5) [Short-time I2t switch.]

(6) Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

(7) Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted. [Zone-selective interlocking shall be provided as shown.]

(8) [Fixed] [Adjustable] ground-fault delay.

(9) [Ground-fault I2t switch.]

(10) [Overload] [and] [short-circuit] [and] [ground-fault] trip indicators shall be provided.

2.10.1.2 Molded-Case Circuit Breakers

NEMA AB 1 and UL 489.

2.10.2 Fuses, Medium-Voltage, Including Current-Limiting

2.10.2.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.10.2.2 Ratings

[Expulsion-type] [Current-limiting] power fuses shall have ratings in accordance with ANSI C37.46 and as follows:

Nominal voltage. ..... [_____].

Rated maximum voltage. ..... [_____].

Maximum symmetrical interrupting capacity. ..... [_____].

Rated continuous current. ..... [_____].

BIL. ..... [_____].

2.10.2.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to ANSI C37.46.

2.10.2.4 C-Rated, Current-Limiting Power Fuses

C-rated, current-limiting power fuses shall open in 1000 seconds at currents between 170 and 240 percent of the C rating.

2.10.3 Fuses, Low-Voltage, Including Current-Limiting

Low-voltage fuses shall conform to NEMA FU 1. Time delay and nontime delay options shall be as [shown] [specified]. Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilizes fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to

less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination.

2.10.3.1 Cartridge Fuses

Cartridge fuses, current-limiting type, Class [G] [J] [K] [L] [RK1] [RK5] [RK9] [T] [CC] shall have tested interrupting capacity not less than [100,000] [200,000] amperes. Fuse holders shall be the type that will reject Class H fuses.

a. Class [G] [J] [L] [CC] fuses shall conform to UL 198C.

b. Class K fuses shall conform to UL 198D.

c. Class R fuses shall conform to UL 198E.

d. Class T fuses shall conform to UL 198H.

2.10.3.2 Transformer Circuit Fuses

Transformer circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.10.4 Instrument Transformers

2.10.4.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE ANSI/IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.10.4.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall not be less than [1.0] [1.2] [1.5] [2.0] [3.0] [4.0]. Other thermal and mechanical ratings of current transformers and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accident open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.10.4.3 Current Transformers for Power Transformers

[Single-ratio] [Multi-ratio] bushing type current transformers shall be provided internally around power transformer bushings as shown. [Single-ratio units shall have a minimum relaying accuracy class of [0.6B-0.5] [0.3B-0.5].] [Multi-ratio units shall have a minimum relaying accuracy voltage class of [_____] for either a C or T classification.]

2.10.4.4 Current Transformers for Metal-Enclosed Switchgear

Single-ratio units, used for metering and relaying, shall have a metering accuracy class rating of [_____] [B._____]. Single-ratio units, used only for relaying, shall have a relaying accuracy class rating of [_____] for [either] a C [or T] classification.

2.10.4.5 Current Transformers for Kwh and Demand Metering (Low-Voltage)

Current transformers shall conform to IEEE ANSI/IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3 through [_____], with a minimum RF of [_____] at 30 degrees C, with 600-volt insulations, and 10 kV BIL. Provide butyl-molded, window-type current transformers mounted [on the transformer low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters.] [in the current transformer cabinet.]

2.10.4.6 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of [_____]. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.10.5 Watthour Meters

Watthour meters shall conform to ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the [drawout switchboard type] [socket mounted [outdoor] [indoor] type] having a [15] [30] [60] [_____] minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than 2-1/2 stators. [Watthour demand meters shall have factory-installed electronic pulse initiators. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of 1 pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment].

2.10.6 Protective Relaying

2.10.6.1 General

[Solid-state] [Microprocessor-based] protective relays shall be provided as shown and shall be of a type specifically designed for use on power switchgear or associated electric power apparatus. Protective relays shall conform to IEEE ANSI/IEEE C37.90. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.10.6.2 Construction

Relays shall be dustproof and moisture resistant. Necessary test devices shall be incorporated within each relay and shall provide a means for testing either from an external source of electric power or from associated instrument transformers. Each relay shall be provided with an operation indicator and an external target reset device. Relays shall have necessary auxiliaries for proper operation. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.10.6.3 Ratings

Relays shall be the manufacturer's standard items of equipment with appropriate ranges for time dial, tap, and other settings. Relay device numbers shall correspond to the function names and descriptions of IEEE ANSI/IEEE C37.2.

2.11 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be [station] [intermediate] [distribution] class, rated as shown. Arresters for use at elevations in excess of 1.8 km (6000 feet) 6000 feet above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the [valve] [or] [metal-oxide varistor] [or] [combination valve-metal-oxide varistor] type.

2.12 GROUNDING AND BONDING

2.12.1 Driven Ground Rods

Ground rods shall be [copper-clad steel conforming to UL 467] [zinc-coated steel conforming to ANSI C135.30] [solid stainless steel] not less than [15.9 mm (5/8 inch) 5/8 inch][19 mm (3/4 inch) 3/4 inch] in diameter by [3.1 m (10 feet) 10 feet][2.44 m (8 feet) 8 feet] in length. Sectional type rods may be used.

2.12.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same

material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.13 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 20 MPa 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200 CONCRETE REINFORCEMENT.

2.14 PADLOCKS

Padlocks shall comply with Section 08700 'Builders' Hardware

2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.15.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.15.2 Fireproofing Tape

Fireproofing tape shall be at least 50 mm (2 inches) 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.15.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 0.254 mm (10 mil) 10 mil thick, conforming to UL 510.

2.16 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than [50] [2] parts per million (ppm) PCB content. In lieu of the

manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding [50] [2] ppm shall be replaced.

2.17 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least [10] [_____] days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard [routine] [design] [and] [other] tests in accordance with IEEE ANSI/IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE ANSI/IEEE C57.98.

c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C37.34 and IEEE ANSI/IEEE C37.41.

d. Protective Relays: Seismic tests in accordance with IEEE ANSI/IEEE C37.98. Surge withstand tests in accordance with IEEE ANSI/IEEE C37.90.1.

e. Relaying Current Transformers: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C57.13.

f. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C57.13.

g. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

h. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C37.20.1, IEEE ANSI/IEEE C37.20.2, and IEEE ANSI/IEEE C37.20.3.

i. Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

j. [_____].

2.18 FENCING

Fencing shall conform to the requirements of Section 02821 CHAIN LINK FENCE.

2.19 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a

fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.19.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: [the source bus and extend down to system bused where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.] [the source bus and extended through the secondary side of transformers for medium voltage distribution feeders.] [the source bus and extend through [outgoing breakers] [outgoing medium voltage feeders, down to the individual protective devices for medium voltage radial taps] [outgoing medium voltage feeders, through the secondary side of transformers] [as indicated] for main electric supply substations.] [the nearest upstream device in the existing source system and extend through the downstream devices at the load end.]

2.19.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. [The Contractor shall coordinate with the [commercial power company] [_____] for fault current availability at the site.] [The Contractor shall utilize the fault current availability indicated as a basis for fault current studies.]

2.19.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.19.4 Fault Current Analysis

2.19.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.19.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.19.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectively has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and any relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.19.6 Study Report

a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document [utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristics curves, current transformer ratios, and relay device numbers and settings;] [and] [existing power system data including time-current characteristic curves and protective device ratings and settings.]

d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed aerially

shall conform to the requirements of Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall have minimum 20 MPa 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.1.3 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.2 CABLE AND BUSWAY INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then [prepare a checklist of significant requirements] [perform pulling calculations and prepare a pulling plan] which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 6.4 mm (1/4 inch) 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 131 cubic centimeters (8 cubic inches) 8 cubic inches of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 10 degrees

C (50 degrees F) 50 degrees F temperature for at least 24 hours before installation.

3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.2.2 Duct Line

[Medium-voltage cables] [Low-voltage cables] [Cables] shall be installed in duct lines where indicated. [Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted.] [Cable joints in medium-voltage cables shall be made in manholes or approved pullboxes only.] Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 Direct-Burial

[Medium-voltage cables] [Low-voltage cables] [Cables] shall be buried directly in the earth as indicated. Minimum cover from the top of a cable to finished grade shall be [_____] mm, [_____] inches, but not less than the depth of the frost line, [_____].

3.2.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 75 mm 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

3.2.3.2 Cable Burial

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as required to pull cables through conduits under paving or railroad tracks. Where cables cross, a separation of at least 75 mm 3 inches shall be provided, unless each cable circuit is protected by a nonmetallic conduit sleeve at the crossing. Where single-conductor cable is installed, all 3 phases and the neutral shall be installed in the same sleeve. Bend radius of any cable shall be not less than [8] [12] [_____] times the diameter of the cable. In no case shall cables be left under longitudinal tension. The first 150 mm 6 inch layer of backfill shall be of sand. Machine compaction shall not be used within 150 mm 6 inches of the cable.

3.2.3.3 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding 1.5 m 5 feet in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts. Ducts shall extend at least 300 mm 1 foot beyond each edge of any paving and at least 1.5 m 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct

from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

3.2.3.4 Medium-Voltage Cable Joints or Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 305 m 1000 feet or less, nor at intervals of less than 305 m 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be installed in above-ground junction boxes or in cast metal splice boxes suitable for direct burial use. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

3.2.3.5 Cable Markers

Markers shall be located [as indicated] [near the ends of cable runs, at each cable joint or splice, at approximately every 150 m 500 feet along cable runs, and at changes in direction of cable runs]. In addition to markers, a 0.127 mm (5 mil), 5 mil, brightly colored plastic tape not less than 75 mm (3 inches) 3 inches in width and suitably inscribed at not more than 3 m (10 feet) 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 300 mm 12 inches below finished grade levels of trenches.

3.2.4 Insect and Rodent Damage

[Animal guards shall be installed as shown.] [Buried fiberglass pads shall be installed as shown.]

3.2.5 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.2.6 Busway Installation

Busways penetrating walls shall have wall flanges installed on both surfaces of walls. Wall openings shall be approximately 6.4 mm 1/4 inch larger than the busway on each of the 4 busway sides, and openings shall be sealed with a suitable compound. Fire barriers shall be provided when penetrating fire rated walls. Fire barriers shall have a rating equal to

the fire wall rating. A weather barrier shall be used when a busway penetrates an exterior wall. Busways shall be supported at intervals not exceeding 3 m 10 feet and shall be braced to prevent lateral movement.

3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.4 FIREPROOFING

[Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing.] [Fire-stops shall be installed in each conduit entering or leaving a manhole.]

3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 inches) 18 inches for ducts of less than 80 mm (3 inch) 3 inch diameter, and 900 mm (36 inches) 36 inches for ducts 80 mm (3 inches) 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 150 mm (6 inches) 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 1.5 m 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe

sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15 m 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 1.2 m 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 150 mm 6 inches vertically.

3.5.4 Nonencased Direct-Burial

Top of duct lines shall be below the frost line depth of [_____] mm, [_____] inches, but not less than [_____] mm [_____] inches below finished grade and shall be installed with a minimum of 75 mm 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 300 mm 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 75 mm 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least1 50 mm. 6 inches. The first 150 mm 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 75 to 150 mm 3 to 6 inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.5.1 Bituminized-Fiber Ducts

Bituminized-fiber ducts shall be used to interface with existing bituminized-fiber duct as shown. To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when temperatures are below minus 18 degrees C (0 degrees F). 0 degrees F. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below0 degrees C (32 degrees F). 32 degrees F.

3.5.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.5.6 Duct Line Markers

Duct line markers shall be provided [as indicated] [at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures]. In addition to markers, a 0.127 mm (5 mil) 5 mil brightly colored plastic tape, not less than 75 mm (3 inches) 3 inches in width and suitably inscribed at not more than 3 m (10 feet) 10 feet on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm 12 inches below finished grade levels of such lines.

3.6 MANHOLES, HANDHOLES, AND PULLBOXES

3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 15 mm 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be

installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.6.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

3.6.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.6.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 15 mm 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.6.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 100 mm 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose. Three-phase transformers shall be installed with [_____] phase sequence. Primary taps shall be set at [_____].

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment [may be either pre-fabricated or] [shall be] poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are

equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 100 mm 4 inches above finished [floor] [paving or grade] and sloped to drain. Edges of concrete pads shall have 20 mm 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 20 MPa 3000 psi compressive strength and comform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200 CONCRETE REINFORCEMENT.

3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed [alike] [as directed by the Contracting Officer].

3.7.3 Fencing

Fencing shall conform to the requirement of and be installed in accordance with Section 02821 CHAIN LINK FENCE. Fences shall provide working clearances for operation and maintenance in accordance with IEEE C2. The entire space between fences and concrete pads shall be excavated to a minimum depth of 100 mm 4 inches below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 15 to 40 mm (1/2 to 1-1/2 inches) 1/2 to 1-1/2 inches graded size up to finished gradelines. Space between fences and concrete pads shall be excavated to a minimum depth of 100 mm 4 inches below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 15 to 40 mm (1/2 to 1-1/2 inches) 1/2 to 1-1/2 inches graded size up to finished gradelines.

3.8 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in [guards] [conduit] to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than 3 m 10 feet apart and with 1 strap not more than 300 mm 12 inches from any bend or termination. Cable guards shall be secured to poles in accordance with the manufacturer's published procedures. Conduits shall be equipped with bushings to protect cables and minimize water entry. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the conduit or guard.

3.8.1 Pole Installation

Pole installation shall be in accordance with Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 1.5 m 5 feet outside of a building and [600 mm] [_____] mm [2] [_____] feet below finished grade as specified and provided under Section 16415 ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed [with caulking compound] [_____] to prevent entrance of moisture or gases into buildings.

3.10 GROUNDING

A ground [mat] [ring] consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed [under] [around] pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from [a transformer,] [a switchgear ground bus,] [and] [a unit substation] to the ground mat. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 300 mm 1 foot below finished grade.

b. Ground mat - A ground mat shall be installed as shown consisting of bare copper conductors installed [300] [450] [600] mm, [12]

[18] [24] inches, plus or minus 75 mm, 3 inches, below the finished top of soil grade. Mat conductors shall be bonded to all rod electrodes, electrolytic electrodes, and to all other intersecting mat conductors. Mat conductors shall be sized as shown on the drawings.

c. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed [300] [450] [600] mm, [12] [18] [24] inches, plus or minus 75 mm, 3 inches, below finished top of soil grade. Ground ring conductors shall be [sized as shown] [No. 2 AWG, minimum].

d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided [interconnected with grounding conductors] [as indicated] to achieve the specified ground resistance. The additional electrodes will be [up to three, [2.4] [3] m ([8] [10] feet)[8] [10] feet rods spaced a minimum of
[3] [3.7] m [10] [12] feet apart] [a single extension-type rod, [15.9] [19.1] mm ([5/8] [3/4] inch) [5/8] [3/4] inch diameter, up to 9.1 m (30 feet) 30 feet long, [driven perpendicular to grade] [coupled and driven with the first rod]]. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 50 mm 2 inches above and 150 mm 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.10.6 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 600 mm 2 feet of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.10.7 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 600 mm. 2 feet.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer [_____] days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of [each grounding electrode] [each grounding electrode system] [the ground mat] [the ground ring] shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - [25] [_____] ohms.

b. Multiple rod electrodes - [_____] ohms.

c. Ground mat - [_____] ohms.

d. Ground ring - [_____] ohms.

3.11.4 Ground-Mat Connection Inspection

All below-grade ground-mat connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer [_____] hours before the site is ready for inspection.

3.11.5 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental

to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.6 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters)

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.11.7 Liquid-Filled Transformer Tests

The following field tests shall be performed on [all liquid-filled transformers] [liquid-filled transformers [_____] kVA and above]. Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

e. [_____]

3.11.8 Dry-Type Transformer Tests

The following field tests shall be performed on [all dry-type transformers] [dry-type transformer [_____] kVA and above]. Pass-fail criteria shall be in accordance with the transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. [_____]

3.11.9 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers. Pass-fail criteria shall be in accordance with the circuit breaker manufacturer's specifications.

a. Insulation resistance test phase-to-phase.

b. Insulation resistance test phase-to-ground.

c. Closed breaker contact resistance test.

d. Power factor test.

e. High-potential test.

f. [Manual] [and] [electrical] operation of the breaker.

3.11.10 Power Circuit Breaker Tests

The following power circuit breakers shall be tested in accordance with ANSI C37.50.

a. [_____].

b. [_____].

c. [_____].

3.11.11 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE ANSI/IEEE C57.13.

3.11.12 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies.

Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

a. Secondary unit substation

b. Pad-mounted transformers

c. Panelboards

d. Switchboards

e. Metal-enclosed switchgear

f. Busways

g. Switches

3.11.13 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.12 MANUFACTURER'S FIELD SERVICE

3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of [_____] hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A [_____] [VHS] format video tape of the entire training session shall be submitted.

3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

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SECTION 16528

EXTERIOR LIGHTING INCLUDING SECURITY AND CCTV APPLICATIONS

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 in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

UNDERWRITERS LABORATORIES (UL)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting System; G, [_____]
Detail Drawings; G, [_____]

Detail drawings for the complete system and for [poles,] [lighting fixtures,] [bracket arms,] [cable boxes,] [handholes,] [transformers,] [controllers,] [and] [_____]. [Detail drawings for precast handholes shall include a design analysis to determine that strength is equivalent to indicated cast-in-place concrete handholes.] [Drawings shall indicate bonding method for concrete encasement.] [Drawings shall include design calculations showing adequate strength of screw foundations.] [For CCTV lighting, data shall include:

a. Infrared light call-up response time.

b. Lamp strike and restrike times.

c. System startup and shutdown operations.

d. Manuals for CCTV Assessment Lighting equipment.

e. A typical zone layout showing light locations, isolux patterns, and lighting ratios.]

As-Built Drawings; [_____], [_____]

Final as-built drawings shall be finished drawings on mylar or vellum and shall be delivered with the final test report.

SD-03 Product Data

Equipment and Materials; [_____], [_____]

Data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

Spare Parts; [_____], [_____]

Spare parts data for each item of material and equipment specified, after approval of detail drawings for materials and equipment, and not later than 4 months before the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and sources of supply.

SD-06 Test Reports

CCTV Assessment Lighting; G, [_____]

Test procedures and reports for CCTV assessment lighting. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

Operating Test; G, [_____]

Test procedures and reports for the Operating Test. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

Ground Resistance Measurements; [_____], [_____]

The measured resistance to ground of each separate grounding installation, indicating the location of the rods, the resistance of the soil in ohms per millimeter and the soil conditions at the time the measurements were made. The information shall be in writing.

SD-10 Operation and Maintenance Data

Lighting System; [_____], [_____]

A draft copy of the operation and maintenance manuals, prior to beginning the tests for use during site testing. Final copies of the manuals as specified bound in hardback, loose-leaf binders, within 30 days after completing the field test. The draft copy used during site testing shall be updated with any changes required, prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the field test shall include modifications made during installation checkout and acceptance.

1.3 SYSTEM DESCRIPTION

1.3.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

1.3.2 Design Requirements for CCTV Assessment Lighting

The CCTV Assessment Lighting system shall be configured as specified and shown. Equipment shall conform to NFPA 70 and IEEE C2. The lighting configuration shall provide sufficient light for optimum CCTV assessment of each zone. The system shall include all fixtures, hardware, poles, cables, connectors, adapters, and appurtenances needed to provide a fully functional lighting system.

1.3.3 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.3.4 Power Line Surge Protection

Transient voltage surge suppressors shall be provided for all electronic equipment. Surge suppressors shall meet the requirements of IEEE C62.41, and be UL listed as having been tested in accordance with UL 1449. Surge suppressor ratings shall be [as indicated] [[_____] volts rms, operating voltage; [50] [60] Hz; [1-phase] [3-phase]; [2] [3] [4] wire with ground; transient suppression voltage (peak let-through-voltage) of [_____] volts]. Fuses shall not be used as surge suppression.

1.3.5 Interface Between CCTV Lighting and CCTV System

Infrared lights shall be interfaced to the CCTV system and shall provide automatic, alarm actuated call-up of the light associated with the alarm zone.

1.3.6 Interface Between Lighting System and Power Distribution

Conductors shall [include all conductors extending from the load side of the primary and secondary power panels that serve assessment lighting equipment] [and] [be as indicated].

1.3.7 Nameplates

Each major component of equipment shall have a nonferrous metal or engraved plastic nameplate which shall show, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

1.3.8 Standard Products

Materials and equipment shall be standard products of manufacturer regularly engaged in the manufacture of such products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.3.9 Unusual Service Conditions

Equipment and materials furnished under this section shall be suitable for the following unusual service conditions: altitude [_____] m,feet, ambient temperature [_____] degrees C. F.

1.3.10 Hazardous Locations

[Wiring shall conform to NFPA 70 for Class [I] [II] [III], Division [1] [2] hazardous locations. Equipment shall be suitable for [Group [_____]] [operating temperature of [_____] degrees C F].] [Wiring and equipment shall be of the classes, groups, divisions indicated, and suitable for the indicated operating temperature.]

1.3.11 Protection of Security Lighting System Components

1.3.11.1 Components and Conductors

Security lighting system conductors shall be protected from damage. Lighting system conductors shall be installed in raceways or by means of direct burial, as shown. Where the conductors leave the underground systems, the conductors shall be in rigid steel conduit of the indicated size. Wire guards shall be provided to protect security lighting luminaries mounted below 6.1 m. 20 feet. A NEMA ICS 6, Type 4 enclosure shall house exterior group-located electrical equipment such as time switches, safety switches, and magnetic contactors. Where only one piece of equipment is being provided at a location, the equipment shall be provided with its own enclosure.

1.3.11.2 Tamper Provisions

Enclosures, cabinets, housings (other than luminaire housings), boxes, raceways, conduits, and fittings having hinged doors or removable covers, and which contain any part of the security lighting system (including power sources), shall be provided with corrosion-resistant tamper switches, connected to an Intrusion Detection System (IDS), that will initiate an alarm signal when the door or cover is opened or moved. Tamper switches shall be inaccessible until the switch is activated. Switch leads and mounting hardware shall be concealed from the exterior of the enclosure. For pull or junction boxes which contain no splices or connections the covers may be protected by 6.4 mm (1/4 inch) 1/4 inch tack welds on four sides of each cover rather than by tamper switches. Labels shall be affixed to indicate they contain no connections. Labels shall not indicate that the box is part of the security system.

1.4 CORROSION PROTECTION

1.4.1 Aluminum Materials

[Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.] [Aluminum shall not be used.]

1.4.2 Ferrous Metal Materials

1.4.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

1.4.2.2 Equipment

Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand [120] [480] hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) 1/16 inch from the test mark. The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D 1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

1.4.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09900 PAINTING, GENERAL.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 BRACKET ARMS

2.2.1 On Aluminum, Steel, Fiberglass, and Concrete Poles

Poles shall be provided with bracket arms of the [support arm] [davit] style and of the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind and ice loading encountered at the site. Strength of bracket arms shall be in accordance with IEEE C136.13. Steel brackets shall be galvanized. Wood bracket arms shall not be used.

2.2.2 On Wood Poles

Poles shall be in accordance with IEEE C136.13 provided with galvanized steel pipe bracket arms coordinated for pole attachment. The bracket arm shall be [cantilever without underbrace] [cantilever with underbrace] [single tie brace] [double tie brace] [truss] [A-frame]. The bracket arm shall be of the length indicated on drawings.

2.2.3 Floodlight Brackets

Floodlight brackets shall be coordinated with the floodlight support provided.

2.3 CABLE

The Contractor shall provide all wire and cable not indicated as government furnished equipment. Wire and cable components shall be able to withstand the jobsite environment for a minimum of 20 years.

2.3.1 Insulated Cable

Cable shall be type USE conforming to UL 854, with copper conductors and type RHW or XHHW insulation conforming to UL 44, and shall include green ground conductor. Cable shall be provided with insulation of a thickness not less than that given in column [A] [B] of TABLE 15.1 of UL 854. Cable shall be rated 600 volts. Parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded.

2.3.2 Messenger Cable

A messenger cable system to support aerial cable shall be furnished. The messenger system shall include guys, hardware and appurtenances needed to install the messenger cable. The messenger system shall be capable of supporting the weight of the lighting system cable with the required messenger cable tensioning without exceeding 30 percent of its breaking strength under 16 degrees C (60 degrees F) 60 degrees F conditions of no ice and no wind. The messenger shall be sized so that ice and wind loading normally encountered at the site does not cause the messenger to exceed 50 percent of its breaking strength. Appurtenances, guys, and hardware shall be sized to exceed the rated breaking strength of the messenger cable. Messenger cables shall be galvanized zinc coated steel or aluminum clad steel.

2.3.3 Bare Copper Conductors

Medium-hard-drawn copper conductors shall conform to ASTM B 2 and ASTM B 8.

2.4 AERIAL CABLE HARDWARE

Zinc coated aerial cable hardware shall conform to ANSI C135.1 and ANSI C135.14. Steel hardware material shall conform to ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.5 CABLE SPLICES AND CONNECTORS

Cable splices and connectors shall conform to UL 486A. Underground splices and connectors shall also conform to the requirements of ANSI C119.1.

2.6 CABLE BOXES

Boxes and covers shall be made of cast iron with zinc coated or aluminized finish, and shall be of the sizes indicated on drawings. The minimum inside dimensions shall be not less than 304.8 mm (12 inches) 12 inches square by 152.4 mm (6 inches) 6 inches deep and not less than required to house the cable splice. A suitable gasket shall be installed between the box and cover for watertightness. A sufficient number of screws shall be installed to hold the cover in place along the entire surface of contact. Grounding lugs shall be provided.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast concrete manholes shall have the required strength established by ASTM C 478. Frames and covers for manholes shall be made of [gray cast iron] [or] [cast steel]. A machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least [69] [_____] MPa [10,000] [_____] psi and a flexural strength of at least [34.5] [_____] MPa [5,000] [_____] psi. Pullbox and handhole covers in parking lots, sidewalks, and turfed areas shall be of the same material as the box. [Concrete pullboxes shall consist of precast

reinforced concrete boxes, extensions, bases, and covers.] [A sufficient number of tamperproof bolts shall be installed to hold the cover firmly in place along the entire surface of contact; a tool for the tamperproof bolts shall be furnished.]

2.8 CONDUIT, DUCTS AND FITTINGS

2.8.1 Conduit, Rigid Steel

Rigid steel conduit shall conform to ANSI C80.1 and UL 6.

2.8.2 Conduit Coatings

Underground metallic conduit and fittings shall be coated with a plastic resin system conforming to NEMA RN 1, Type 40. Epoxy systems may also be used.

2.8.3 Conduit Fittings and Outlets

2.8.3.1 Boxes, Metallic Outlets

NEMA OS 1 and UL 514A.

2.8.3.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.8.3.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.8.3.4 Boxes, Switch (Enclosed), Surface Mounted

UL 98.

2.8.3.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.8.3.6 Fittings for Use in Hazardous (Classified) Locations

UL 886.

2.8.3.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.8.4 Non-Metallic Duct

Non-metallic duct lines and fittings utilized for underground installation shall be suitable for the application. Duct shall be thick-wall, single, round-bore type. Material of one type shall be used. Acrylonitrile-butadiene-styrene (ABS) duct shall conform to NEMA TC 6and NEMA TC 9. High-density conduit shall conform to UL 651A. Schedule 40 polyvinyl chloride (PVC) shall conform to UL 651. Plastic utility duct and fittings manufactured without a UL label or listing shall be provided with a certification as follows: "The materials are suitable for use with 75

degree C (167 degrees F) 167 degree F wiring. No reduction of properties in excess of that specified for materials with a UL label or listing will be experienced if samples of the finished product are operated continuously under the normal conditions that produce the highest temperature in the duct."

2.9 WOOD CROSSARMS

Douglas fir or dense southern pine of sizes specified or indicated, with pressure treatment conforming to AWPA C25.

2.10 GROUND RODS

Ground rods shall be of [copper clad steel conforming to UL 467] [zinc coated steel conforming to ANSI C135.30] [solid stainless steel] not less than [15.9 mm (5/8 inch)] [19.1 mm (3/4 inch)] [5/8] [3/4] inch in diameter by [2.4 m (8 feet)] [3.1 m (10 feet)] [8] [10] feet in length of the sectional type driven full length into earth.

2.11 POLES

Metal and concrete poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for a wind velocity of [31.3 meters per second (70 mph)] [35.8 meters per second (80 mph)] [40.2 meters per second (90 mph)] [44.7 meters per second (100 mph)] [49.2 meters per second (110 mph)] [[_____] meters per second ([_____] mph)] [70] [80] [90] [100] [110] [_____] mph at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-3. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

2.11.1 Aluminum Poles

Aluminum poles and brackets for [walkway] [_____] lighting shall have a [uniform satin] [dark anodic bronze] [_____] finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

a. Shafts shall be round and of seamless construction. The wall thickness shall be at least 4.8 mm (0.188 in). 0.188 inch. Exterior surfaces shall be free of protuberances, dents, cracks, and discoloration. Material for shafts shall be 6063 aluminum alloy; after fabrication, the alloy shall have a T6 temper. Tops of shafts shall be fitted with a round or tapered cover. Bases shall be anchor bolt mounted, made of cast aluminum alloy 356-T6, and shall be machined to receive the lower end of shafts. Joints between shafts and bases shall be welded. Bases shall be provided with four holes, spaced 90 degrees apart, for anchorage.

b. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.

2.11.2 Steel Poles

Steel poles shall be hot-dip galvanized in accordance with ASTM A 123/A 123M and shall not be painted. Poles shall have tapered tubular members, either round in cross-section or polygonal. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 900 to 1270 mm 3 to 4 feet above grade and shall include manufacturer, year of manufacture, top and bottom diameters, length, and a loading tree. Attachment requirements shall be provided as indicated, including grounding provisions. Climbing facilities are not required. Bases shall be of the anchor bolt-mounted type.

2.11.3 Concrete Poles

Concrete poles shall be designed to withstand the loads specified in IEEE C2 multiplied by the appropriate overload capacity factors. Poles shall be reinforced or prestressed, either cast or spun. Spun poles shall be manufactured by a centrifugal spinning process with concrete pumped into a polished round tapered metal mold. Concrete for spun poles shall have a compressive strength of at least 34.5 MPa (5,000 psi) 5,000 psi at 28 days; steel wire shall have an ultimate tensile strength of at least 827 MPa (120,000 psi); 120,000 psi; and reinforcing bars shall have an ultimate tensile strength of at least 276 MPa (40,000 psi). 40,000 psi. After the high speed spinning action is completed, a spun pole shall be cured by a suitable wet steam process. Spun poles shall have a water absorption of not greater than 3 percent to eliminate cracking and to prevent erosion. Concrete poles shall have hollow shafts. Poles shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost. Poles shall not be installed for at least 15 days after manufacture. Fittings and brackets that conform to the concrete pole design shall be provided. Poles shall conform to strength calculations performed by a registered professional engineer and submitted in accordance with detail drawings portion of paragraph SUBMITTALS.

2.11.4 Wood Poles

Wood poles shall conform to ANSI O5.1. Poles shall be pressure treated in accordance with AWPA C4 with creosote conforming to AWPA P1/P13 and oil-borne preservatives and petroleum conforming to AWPA P8 and AWPA P9. Species listed in ANSI O5.1 for which a preservative treatment is not specified in AWPA C4 shall not be used. Northern white cedar may be used if treated as specified for western red cedar, and western fir may be used if treated as specified for Douglas fir. Pole markings shall be located approximately 3 m 10 feet from the butt of the pole or as approved. Poles shall be machine trimmed by turning smooth full length and shall be roofed, gained, and bored before pressure treatment.

2.11.5 Fiberglass Poles

Fiberglass poles shall conform to ANSI C136.20 and shall be designed specifically for supporting luminaires and shall have factory-formed cable entrance and handholes. Resin color shall be [dark bronze] [as indicated], and pigment shall provide uniform coloration throughout entire wall thickness. Finished surface shall be pigmented polyurethane which may be omitted if the surface layer of the pole is inherently ultra-violet inhibited. Minimum fiberglass content shall be 65 percent with resin and pigment comprising the other 35 percent material content.

2.11.6 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.12 POLE LINE HARDWARE

Zinc coated hardware shall conform to ANSI C135.1 and ANSI C135.14, and steel hardware material shall conform to ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.13 SERIES ROADWAY LIGHTING INSULATORS

Pin insulators shall be Class 55-5. Line-post insulators shall be Class 57-1 or 57-11.

2.14 ELECTRICAL ENCLOSURES

The Contractor shall provide metallic enclosures as needed to house the [security] [and] [CCTV] lighting equipment. Enclosures shall conform to NEMA ICS 6 and NEMA 250. Enclosures shall be provided with lockable or padlock handles. Keys for lockable enclosures shall be delivered to the Contracting Officer. The enclosures shall be as specified or as shown on the drawings.

2.14.1 Interior Enclosures

Enclosures to house lighting equipment in an interior environment shall meet the requirements of a NEMA 12 enclosure as defined in NEMA 250.

2.14.2 Exposed-to-Weather Enclosures

Enclosures to house lighting equipment in an outdoor environment shall meet the requirements of a NEMA 4 enclosure as defined in NEMA 250.

2.14.3 Corrosion Resistant Enclosures

Enclosures to house lighting equipment in a corrosive environment shall meet the requirements of a NEMA 4X enclosure as defined in NEMA 250.

2.14.4 Hazardous Environment Enclosures

Equipment installed in a hazardous environment shall be installed as described in paragraph Hazardous Locations.

2.15 ILLUMINATION

2.15.1 General Lighting

Luminaires, ballasts, lamps, and control devices required for [general area] [and] [_____] lighting [, including floodlighting] shall be in accordance with [sheet] [sheets] [_____] of Standard Detail No. 40-06-04, attached to these specifications.

2.15.2 Roadway Lighting

Luminaires, ballasts, lamps, and control devices required for roadway lighting shall be in accordance with [sheet] [sheets] [_____] of Standard Detail No. 40-06-04, attached to these specifications.

2.16 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

2.16.1 High-Pressure Sodium

Lamps shall conform to [ANSI C78.1350] [or ANSI C78.1351] [or ANSI C78.1352] [or ANSI C78.1355]. Ballasts shall conform to ANSI C82.4, or UL 1029. High-pressure sodium lamps shall be clear.

2.16.2 Mercury Vapor

Lamps shall conform to ANSI C78.40. Ballasts shall conform to ANSI C82.4.

2.16.3 Metal-Halide

Lamps shall be made by a manufacturer with not less than 5 years experience in making metal-halide lamps. Metal-halide lamps shall conform to ANSI C78.1375 or ANSI C78.1376. Ballasts shall conform to ANSI C82.4 or UL 1029.

2.17 LAMPS, INCANDESCENT

Incandescent lamps shall conform to UL 1571 and shall be rated for 120 volt operation unless otherwise specified.

2.18 LAMPS, FLUORESCENT

Fluorescent lamps shall have standard cool-white color characteristics and shall not require starter switches. The lamps shall be of the rapid-start type.

2.19 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

2.20 LIGHTING CONTROL EQUIPMENT

2.20.1 Photo-Control Devices

Photo-control devices shall conform to ANSI C136.10. Each photo-control element shall be a replaceable, weatherproof, plug-in or twist-lock

assembly adjustable operation range of approximately 5.4 to 53.8 lux. 0.5 to 5.0 foot-candles. Luminaires shall be equipped with weatherproof plug-in or twist-lock receptacle to receive the photo-control element.

2.20.2 Timer Control Switches

Astronomic dial type arranged to turn "ON" at sunset, and turn "OFF" at a pre-determined time between [2030 hours] [_____] hours and [0230 hours] [_____] hours or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise shall be provided. A switch rated [_____] volts, having [automatically wound spring mechanism] [battery backed electronic clock] to maintain accurate time for a minimum of 7 hours following a power failure shall be provided. A time switch with a manual on-off bypass switch shall be provided. Housing for the time switch shall be a surface mounted, NEMA [3R] [1 (indoor)] [4 (outdoor)] enclosure conforming to NEMA ICS 6.

2.20.3 Manual Control Switches

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall have a minimum of three positions: ON, OFF, and AUTOMATIC. The automatic selection shall be used when photoelectric or timer control is desired. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

2.20.4 Safety Switches

Switches shall be the heavy-duty type with NEMA ICS 6 Type [1] [4] enclosures and shall be suitable for operation on a [480Y/277] [208Y/120] [480] [277] [240] [120] volt, 60 Hz, [three-phase] [single-phase] system. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. Blades shall be visible with door open and shall be of the quick-make, quick-break type. Terminal lugs shall be coordinated with the wire size. Switches shall conform to UL 98.

2.20.5 Magnetic Contactor

Magnetic contactors shall be mechanically held, electrically operated, and shall conform to NEMA ICS 1 and NEMA ICS 2. The contactor shall be suitable for [480] [277] [240] [208] [120] volts, [single] [3] phase, 60 Hz. Coil voltage shall be [120] [277] [208] [240] volts. Maximum continuous ampere rating and number of poles shall be as indicated on drawings. Enclosures for contactors mounted indoors shall be NEMA ICS 6, Type 1. Each contactor shall be provided with a spare, normally open auxiliary contact. Terminal lugs shall be coordinated with the wire size.

2.21 PHOTOMETRIC DISTRIBUTION CLASSIFICATION

Photometrics shall conform to IESNA RP-8.

2.22 LUMINAIRES, FLOODLIGHTING

2.22.1 HID and Incandescent

HID lighting fixtures shall conform to UL 1572. Incandescent lighting fixtures shall conform to UL 1571.

2.22.2 Fluorescent

Fluorescent lamps shall conform to ANSI C78.1.

2.23 FIXTURES

Standard fixtures shall be as detailed on Standard Detail No. 40-06-04, Sheet Nos. [_____] which accompany and form a part of this specification. Special fixtures shall be as indicated on the drawings. Illustrations

shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, equal finish and quality will be acceptable as approved.

2.23.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

2.23.2 Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special Type 1.

2.23.3 In-Line Fuse

An in-line fuse shall be provided for each fixture, and shall consist of a fuse and a UL approved waterproof fuse holder rated [at 30 amperes, 600 volts] [as indicated], with insulated boots. Fuse rating shall be [600 volts] [as indicated].

2.24 SEARCHLIGHTS

Special type [_____] searchlights shall be [304.8 mm (12 inch) 12 inch] [457.2 mm (18 inch) 18 inch] [609.6 mm (24 inch) 24 inch] nominal size and shall be of weatherproof, dust-tight, corrosion-resistant construction. Each searchlight shall include a housing and hinged door, two reflectors, a receptacle, a trunnion, and a base. Searchlights shall be provided for operation at [120 Vac] [[_____] Vdc]. Each searchlight shall have a range for observing objects the size of an automobile at [243.8 m (800 feet)] [365.8 m (1200 feet)] [457.2 m (1500 feet)] [609.6 m (2000 feet)] [800] [1200] [1500] [2000] feet on a clear night. Searchlights shall be [hand-controlled, with pedestal base and slip rings] [pilot-house controlled, with low base and slip rings]. The housing and hinged door shall be made of nonferrous metal. A heat-resistant, clear, smooth cover glass tempered to withstand sudden changes in temperature shall be gasketed

and mounted to the door. The door shall be gasketed to form a weatherproof seal. A parabolic reflector of silver-mirrored glass or aluminum approximately 6.4 mm 1/4 inch thick shall be mounted at the back of the housing, and a spherical auxiliary reflector designed to permit relamping shall be mounted in front of the lamp. The auxiliary reflector shall have a permanent, nontarnishing, nonabsorptive aluminum oxide reflecting surface. Receptacle shall be of proper size to receive the lamp and shall be installed in a manner to ensure accurate positioning of the light center. Searchlights shall be arranged for horizontal and vertical adjustment. Stranded, two-conductor, weatherproof, flexible cable shall feed out of the housing through a weatherproof entrance bushing. Searchlights shall be optically arranged to provide a horizontal and vertical beam spread of [2.5] [3.5] [4.5] [5.5] [6.5] [7.5] [8.5] [_____] degrees. Provision shall be made for tilting searchlights to any position within 45 degrees above and below the horizontal. The searchlights shall be provided with slip rings to permit continuous horizontal rotation. [Each searchlight installation shall include a [_____] 12 volt [_____] kVA transformer conforming to UL 506.] [Searchlight installation on guard towers Nos. [_____] shall also include a manually operated, two-pole, enclosed transfer switch, a 200 ampere-hour, 12 volt, lead-acid, flat pasted positive plate design storage battery, and an automatic battery charger. The battery charger shall be silicon type, full wave, with high and low charging rate, arranged to go on high rate after resumption of power and emergency discharge, and return to low rate automatically when battery has reached full charge. An ammeter shall be provided in the charging circuit to indicate rate of charge.]

2.25 FRESNEL-LENS LUMINAIRES

Special type [_____] luminaires shall consist of mounting bracket, head, socket, reflector, and fresnel-lens assembly for multiple circuit. Luminaire shall be of weatherproof, dust tight, and insect proof construction. Mounting bracket shall be for [crossarm] [[38.1] [50.8] mm ([1-1/2] [2] in) [1-1/2] [2] in slip fitter] [wood-pole] [pipe] mounting. Readily accessible means shall be provided to permit horizontal adjustment and locking of the luminaire within a 30 degree arc each side of the center, and tilting and locking the luminaire within a 30 degree arc each side of vertical. The length of the mounting bracket shall be such that the center of the luminaire, when hanging vertically, will be not less than 200 mm 8 inches nor more than 600 mm 2 feet from the surface of the pole or cross-arm. [Luminaire shall have a 300 watt incandescent lamp that will produce an average candela not less than 3000.] [Luminaire shall have a 500 watt incandescent lamp that will produce an average candela of not less than 5000.] The unit shall be provided with an auxiliary reflector of white glossy-type porcelain enamel or aluminum reflecting surface. The assembly, consisting of a 180 degree cylindrical fresnel lens and a semicylindrical reflector housing, shall produce a horizontal beam spread of approximately 180 degrees, and a vertical beam spread of approximately 15 to 25 degrees.

2.26 FLUORESCENT FLOODLIGHTS, EXTERIOR

Special type [_____] fluorescent floodlight fixtures shall be suitable for outdoor installations and shall use a 2.4 meter (96 inch), 96 inch, T-12, rapid start, 1.5 ampere lamp. The fixture shall consist of a highly polished aluminum reflector with specular finish. The fixture sockets shall be spring loaded, and shall have plunger sockets with silver-plated contacts and neoprene boots. The fixture shall have provisions for aiming throughout 360 degrees of rotation with a graduated aiming dial. Door assembly shall consist of a stainless steel frame, a clear acrylic plastic cover, a sponge neoprene weatherproof gasket, and stainless steel hinges and latches. Housing shall be finished with [green] [_____] acrylic baked enamel. The fixture shall be equipped with a mounting hub assembly at each end. The fixture shall be provided with a thermally protected, weatherproof, high power factor ballast, not integral with the fixture, for remote mounting. The ballast shall be rated for minus 29 degrees C (minus 20 degrees F) minus 20 degrees F for cold weather starting.

2.27 TRANSFORMERS

Transformers shall conform to UL 506. Exterior transformer cases shall be given rust-inhibiting treatment and standard finish by the manufacturer.

2.27.1 Outdoor Dry-Type Lighting Transformers

Transformers shall be single phase, 60 Hz, two winding, with two wire secondary and with a [240] [480] [_____] volt primary to 12O volt secondary, [1] [_____] kVA.

2.27.2 Buck-Boost Transformers

Transformers shall be suitable for outdoor installation. The transformers shall have a 150 degree C insulation system for an 80 degree C rise. Transformers shall be for 60 Hz with 4 windings, 2 for primary and 2 for secondary, with all leads brought out to permit parallel or series connections of primary and secondary windings. The voltage ratings, kVA ratings, percent of boost and/or buck, and connections shall be as indicated on drawings.

2.28 WIREWAY, RAINTIGHT, SUPPORT

Raintight wireway shall conform to UL 870. Wireway used for supporting floodlights on wood poles shall be [101.6 x 101.6 mm] [_____] [4 x 4 inches] [_____] and length shall be [1.8 meters] [_____] [6 feet] [____] [as indicated].

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents, and shall furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Current Site Conditions

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Government.

The Contractor shall not take any corrective action without written permission from the Government.

3.1.2 Existing Equipment

The Contractor shall connect to and utilize existing lighting equipment and devices as shown. Lighting equipment that is usable in their original configuration without modification may be reused with Government approval. The Contractor shall perform a field survey, including testing and inspection of existing lighting equipment and control lines intended to be incorporated into the lighting system, and furnish a report to the Government. For those items considered nonfunctioning, specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency shall be provided with the report. As part of the report, the Contractor shall include the scheduled need date for connection to all existing equipment. The Contractor shall make written requests and obtain approval prior to disconnecting any control lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Government approval of these requests. If any device fails after the Contractor has commenced work on that device, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment. The Government is responsible for maintenance and repair of Government equipment. The Contractor shall be held responsible for repair costs due to Contractor negligence or abuse of Government equipment.

3.2 ENCLOSURE PENETRATIONS

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.3 PREVENTION OF CORROSION

3.3.1 Aluminum

Aluminum shall not be used in contact with earth or concrete, and where connected to dissimilar metal, shall be protected by approved fittings and treatment.

3.3.2 Steel Conduits

Steel conduits shall not be installed within concrete slabs-on-grade. Steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, shall be field wrapped with 254 micrometers (0.010 inch) 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

3.3.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.4 CABLE INSTALLATION

Cable and all parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Each circuit shall be identified by means of fiber or nonferrous metal tags, or approved equal, in each [handhole] [and] [junction box,] and at each terminal.

3.4.1 Splices

Splices below grade shall be made with nonpressure-filled resin systems using transparent, interlocking, self-venting, longitudinally split plastic molds. Splices above grade shall be made with sealed insulated pressure connectors and shall provide insulation and jacket equal to that of the cable. In order to prevent moisture from entering the splice, jackets shall be cut back to expose the required length of insulation between the jacket and the tapered end of the insulation.

3.4.2 Installation in Duct Lines

[Ground] [Ground and neutral] conductors shall be installed in duct with the associated phase conductors. Cable splices shall be made in handholes only.

3.4.3 Direct Burial

Minimum cover from top of cable to finished grade shall be 750 mm 30 inches for direct buried cable, but not less than the depth of the frost line.

3.4.3.1 Trenching

Trenches shall be excavated to the depths required to provide the minimum cable cover. The bottom of the trench shall be smooth and free of stones and sharp objects. Where the bottom of the trench consists of material other than sand or earth, an additional 75 mm 3 inch layer shall be removed and replaced by a 75 mm 3 inch layer of sand or stone-free earth compacted to the approximate density of the surrounding firm soil. The cables shall be unreeled in place along the side of or in the trench and carefully

placed on the sand or earth bottom. Pulling cables into a direct-burial trench from a fixed reel position will not be permitted. Where cables cross, a separation of at least 75 mm 3 inches shall be provided, unless the cables are protected by nonmetallic conduit sleeves at the crossing. The radius of bends in cables shall be not less than 12 times the diameter of the cable. Cables shall not be left under longitudinal tension. The first layer of backfill shall be 150 mm 6 inches thick and shall consist of sand or stone-free earth. One-inch untreated planks, not less than 200 mm 8 inches in width, or approved equal protection, shall be placed end to end along the cable run, approximately 75 mm 3 inches above the cable. A 0.127 mm (5 mil), 5 mil, brightly colored plastic tape not less than 75 mm3 inches in width and suitably inscribed at not more than 3 m 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 300 mm 12 inches below finished grade levels of trenches. Selected backfill of sand or stone-free earth shall be provided to a minimum depth of 75 mm 3 inches above cables.

3.4.3.2 Requirements for Installation in Duct

Where indicated on drawing, cable shall be installed in duct lines. Ground and neutral conductors shall be installed in duct with the associated phase conductors. The segments of direct-burial cable that cross under new railroad tracks, roads, or paving exceeding 1.5 m 5 feet in width, shall be installed in plastic, or rubber duct encased in concrete in accordance with paragraph DUCT LINES. Pulling of cable into conduit from a fixed reel position will be permitted. At interfaces with direct-burial cable, the direct-burial cable shall be centered in the entrance to the duct, using an approved waterproof, nonhardening mastic compound to facilitate the centering. Where crossing existing railroad tracks, coated rigid steel conduit shall be installed under the tracks, in lieu of concrete-encased duct, in accordance with paragraph DUCT LINES. Installation shall be in accordance with NFPA 70 and the regulations of the railroad.

3.4.3.3 Location of Cable Splices

Splices in direct-burial cable will not be permitted in runs of 150 m 500 feet or less or at intervals of less than 150 m 500 feet in longer runs except as required for taps. Where cable splices in shorter intervals are required to avoid obstructions or damage to the cable, the location shall be as approved. Cable splices shall be installed in cable boxes or concrete handholes.

3.4.3.4 Markers

Cable and cable splice markers shall be located near the ends of cables, at each cable splice, approximately every 120 m 400 feet along the cable run, and at changes in direction of the cable run. Markers need not be placed along cables laid in relatively straight lines between lighting poles that are spaced less than 120 m 400 feet apart. Markers shall be placed approximately 600 mm 2 feet to the right of the cable or cable splice when facing the longitudinal axis of the cable in the direction of the electrical load. The marker shall be concrete with a 28 day compressive strength of 17 MPa (2500 psi) 2500 psi in accordance with Section 03300

CAST-IN-PLACE STRUCTURAL CONCRETE. The letter "C" shall be impressed in the top of each marker.

3.4.3.5 Warning Tape

Direct burial cable shall be placed below a plastic warning tape buried in the same trench or slot. A 0.127 mm (5 mil) 5 mil brightly colored plastic tape, not less than 75 mm (3 inches) 3 inches in width and suitably inscribed at not more than 3 m (10 feet) 10 feet on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) 1 mil metallic foil core to permit easy location of the buried cable, shall be placed approximately 300 mm 12 inches below finished grade.

3.4.4 Messenger Cable

3.4.4.1 Installation

Messenger shall be attached to poles with approved clamps and not less than 15.9 mm (5/8 inch) 5/8 inch through bolts. Messenger cable tensioning shall not exceed 30 percent of its rated breaking strength under 16 degrees C (60 degrees F) 60 degrees F conditions of no ice and no wind. Messengers shall be stressed to a tension higher than the final tension in order to prestretch the cable, so that when the messenger is dead-ended under its final tension and sag, there shall be minimum variation from the calculated values.

3.4.4.2 Grounding and Bonding Connections

Messengers shall be grounded and guyed at corners, dead-ends, and entrances to each facility, and grounded at intervals not exceeding 300 m. 1000 feet. [New grounding conductors and electrodes shall be provided at each ground connection.] [Where grounding connections are made in the vicinity of existing grounding conductors and electrodes, the grounding connection may be made by a bolted or welded connection to the existing grounding conductor.] Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors. 3.4.4.3 Grounding Conductors and Electrodes

Ground conductors shall be soft drawn copper, having a current capacity of at least 20 percent of that of the messenger to which it is connected. Ground conductors shall not be smaller than No. 6 AWG. The ground conductor shall be connected to a ground rod of [copper clad steel conforming to UL 467] [zinc coated steel conforming to ANSI C135.30] [solid stainless steel] not less than [15.9 mm (5/8 inch)] [19.1 mm (3/4 inch)] [5/8] [3/4] inch in diameter by [2.4 m (8 feet)] [3.1 mm (10 feet)] [8] [10] feet in length. After installation is completed, the top of the ground rod shall be approximately 300 mm 1 foot below finished grade. The ground conductor shall be protected by half-round wood, plastic, or fiber molding from the ground to a point at least 2.4 m 8 feet above the ground.

3.4.4.4 Ground Resistance Testing

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance shall not exceed

25 ohms under normally dry conditions. Whenever the required ground resistance is not met, additional electrodes shall be provided, [interconnected with grounding conductors] [as indicated], to achieve the specified ground resistance. The additional electrodes shall be [up to three [[2.4 m][3 m] [8 feet] [10 feet]] long rods spaced a minimum of 3 m 10 feet apart] [a single extension type rod, [[15.9 mm] [19.1 mm] [5/8 inch] [3/4 inch]] in diameter, up to 9.1 m 30 feet long [driven perpendicular to grade] [coupled and driven with the first rod]]. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.5 AERIAL CABLE SPLICES

Splices in aerial cable shall be within 900 mm 3 feet of a pole and placed inside a watertight enclosure. Drip loops shall be formed at the cable entrance to the enclosure. Lashing clamps shall be placed within 300 mm 12 inches of the enclosure.

3.6 LASHING WIRE

Lashing wire shall be wound tightly around both the communication cable and the messenger cable by machine methods. The lashing wire shall have a minimum of one turn per 355.6 linear mm (14 linear inches) 14 linear inches and not less than the number of turns per linear meter (linear foot) linear foot that is recommended by the cable manufacturer for the distance between cable support points and the combined ice and wind loading and extreme wind loading shown or normally encountered for the installed location. Lashing clamps shall be placed at all poles and splices.

3.7 STRESS LOOPS

Loops shall be formed in the aerial cable at all points of connection and at all poles to prevent damage from thermal stress and wind loading. Aerial cable shall be protected from chafing and physical damage with the use of spiral cut tubing and PVC tape, or plastic sleeves.

3.8 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated and shall be properly connected to the indicated equipment. Empty conduits to the indicated equipment from a point 1.5 m 5 feet outside the building wall and 600 mm 2 feet below finished grade [are specified in Section 16415 ELECTRICAL WORK, INTERIOR] [shall be provided]. After installation of cables, conduits shall be sealed to prevent moisture or gases from entering the building.

3.9 DUCT LINES

3.9.1 Requirements

Numbers and size of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. 4 inches per 100 feet. Depending on the contour of the finished grade, the high point may be at a terminal,

a manhole, a handhole, or between manholes or handholes. Short radius manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 inches) 18 inches for ducts of less than 80 mm (3 inches) 3 inches in diameter, and 900 mm (36 inches) 36 inches for duct 80 mm (3 inches) 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m (25 feet) 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes.

3.9.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and shall match factory tapers. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.9.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70 except that electrical duct bank configurations for ducts 150 mm (6 inches) 6 inches in diameter shall be determined by calculation and as shown on the drawings. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, except railroad and airfield crossings, tops of concrete encasements shall not be less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface landings. Tops of concrete encasement shall not be less than 1.5 m 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit shall be installed. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15 m 50 feet in length, the predrilling method or the jack-and-sleeve method shall be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not more than 1.2 m 4 foot on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete, and joints shall be staggered at least 150 mm 6 inches vertically.

3.9.4 Nonencased Direct-Burial

Top of duct lines shall be below the frost line depth of [_____] mm, inches, but not less than [_____] mm inches below finished grade and shall be installed with a minimum of 75 mm 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 300 mm 12 inches of earth is required. Bottom of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 75 mm 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 150 mm. 6 inches. The first 150 mm 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 75 to 150 mm 3 to 6 inch layers. Duct banks may be held in alignment with earth. However, high tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.9.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendation for the particular type of duct and coupling selected and as approved.

3.9.5.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4 turn to set the joint tightly.

3.9.6 Concrete

Concrete work shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be plain, 17 MPa (2500 psi) 2500 psi at 28 days, except that reinforced concrete shall be 21 MPa (3000 psi) 3000 psiat 28 days. Duct line encasement shall be of monolithic construction. Where a connection is made to an existing duct line, the concrete encasement shall be well bonded or doweled to the existing encasement.

3.9.7 Duct Line Markers

Duct line markers shall be provided [as indicated] [at the ends of long duct line stubouts or for other duct locations that are indeterminate because of duct curvature or terminations at completely below-grade structures]. In addition to markers, a 0.127 mm (5 mil) 5 mil brightly colored plastic tape, not less than 75 mm (3 inches) 3 inches in width and suitably inscribed at not more than 3 m (10 feet) 10 feet on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm 12 inches below finished grade levels of such lines.

3.10 HANDHOLES

The exact locations shall be determined after carefully considering the locations of other utilities, grading, and paving. Exact locations shall be approved before construction is started.

3.10.1 Construction

Handholes shall be constructed as indicated on drawings, including appurtenances. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic construction. Concrete shall be 21 MPa 3000 psi at 28 days. Precast concrete handholes having the same strength and inside dimensions as cast-in-place concrete handholes may be used. In paved areas, the top of entrance covers shall be flush with the finished surface of the paving. In unpaved areas, the top of entrance covers shall be approximately 15 mm 1/2 inch above the finished grade. Where finished grades are in cut areas, unmortared brick shall be installed between the top of handhole and entrance frame to temporarily elevate the entrance cover to existing grade level. Where duct lines enter walls, the sections of duct may be cast in the concrete or may enter the wall through a suitable opening. The openings around entering duct lines shall be caulked tight with lead wool or other approved material.

3.10.2 Appurtenances

The following appurtenances shall be provided for each handhole.

3.10.3 Cable Pulling-In Irons

A cable pulling-in iron shall be installed in the wall opposite each duct line entrance.

3.10.4 Ground Rods

In each handhole, at a convenient point close to the wall, a ground rod conforming to paragraph GROUNDING shall be driven into the earth before the floor is poured; approximately 100 mm 4 inches of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor; a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall.

3.11 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting height of [9.1 m (30 feet)] [10.7 m (35 feet)] [12.2 m (40 feet)] [[_____] m ([_____] feet).] [30] [35] [40] [_____] feet. Luminaire mounting height may be increased by the height of the transformer base where required. Electrical cabling shall be provided to the light pole as specified in Section [_____]. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Light poles shall not be installed outside the site or inside the perimeter zone. [CCTV light poles shall be

installed inside the secure area and 1.5 m 5 feet from the inner perimeter fence.] [Security system light poles shall be installed inside the secure

area.] Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and IEEE C2. Poles shall be set straight and plumb.

3.11.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the mount, luminaire, and housing with wind and ice loading normally encountered at the site. [CCTV luminaires shall be located inside the perimeter zone and at a minimum of 9 m 30 feet vertically above the finished grade.] [When security lights are used along roadways, brackets shall correctly position roadway luminaires and fresnel-lens luminaires not less than [1.2] [1.8] [2.4] [3.1] [3.7] or [4.6] m [4] [6] [8] [10] [12] [or] [15] feet from the pole, at not less than the mounting height specified by the fixture manufacturer.] Pole brackets for floodlights shall have the number of tenons indicated, arranged to provide the indicated spread between each tenon. Where indicated on drawings, adjustable heads shall be installed on the brackets to position the luminaires. Identical brackets shall be used with one type of luminaire.

3.11.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be 21 MPa (3000 psi) 3000 psi at 28 days.

3.11.3 Rigid Steel Conduit Ells

Rigid steel conduit ells shall be provided [at all poles] [where specified or indicated on drawings]. Rigid steel conduit shall be connected to the ells and shall extend to a minimum height of 3 m 10 feet above grade. Rigid steel conduit ells shall be provided for wood poles, where required

3.11.4 Wood Pole Installation

Wood poles shall be set straight and firm. In normal firm ground, minimum pole-setting depths shall be as listed in Table II. In rocky or swampy ground, pole-setting depths shall be decreased or increased [as shown] [respectively in accordance with the local utility's published standards and as approved]. In swampy or soft ground, a bog shoe shall be used where support for a pole is required. Poles in straight runs shall be in a straight line. Curved poles shall be placed with curvatures in the direction of the pole line. Poles shall be set to maintain as even a grade as practicable. When the average ground run is level, consecutive poles shall not vary more than 1.5 m 5 feet in height. When the ground is

uneven, poles differing in length shall be kept to minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top end and

roofed. If any pole is shortened after treatment, the shortened end of the pole shall be given an application of hot preservative. Where poles are set on hilly terrain, along edges of cuts or embankments, or where soil may be washed out, special precautions shall be taken to ensure durable pole foundations, and the setting depth shall be measured from the lower side of the pole. Holes shall be dug large enough to permit proper use of tampers to the full depth of a hole. Earth shall be placed into a hole in 15 cm 6 inch maximum layers, then thoroughly tamped before the next layer is placed. Surplus earth shall be placed around a pole in a cone and packed tightly to drain water from poles.

TABLE I - MINIMUM POLE-SETTING DEPTH (Meters)

Length Overall Meters	Straight Lines	Curves, Corners, and Points of Extra Strain
6.1	1.5	1.5
7.6	1.7	1.7
9.2	1.7	1.7
10.7	1.8	1.8
12.2	1.8	2.0
13.7	2.0	2.1
15.2	2.1	2.3
16.7	2.3	2.5
18.3	2.5	2.6

TABLE I - MINIMUM POLE-SETTING DEPTH (Feet and Inches)

Length Overall Feet	Straight Lines	Curves, Corners, and Points of Extra Strain
20	5-0	5-0
25	5-6	5-6
30	5-6	5-6
35	6-0	6-0
40	6-0	6-6
45	6-6	7-0
50	7-0	7-6
55	7-6	8-0
60	8-0	8-6

3.11.5 Aluminum, Steel, Fiberglass and Concrete Pole Installation

Poles shall be mounted on cast-in-place or power-installed screw foundations. Concrete poles shall be embedded in accordance with the details shown. Conduit elbows shall be provided for cable entrances into pole interiors.

3.11.5.1 Cast-In-Place Foundations

Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. Concrete work and grouting is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufactures standard, and not less than necessary to meet the pole wind loading and other specified design requirements.

3.11.5.2 Power-Installed Screw Foundations

Power-installed screw foundations having the required strength mounting bolt and top plate dimensions may be utilized. Screw foundations shall be of at least 6.4 mm (1/4 inch) 1/4 inch thick structural steel conforming to ASTM A 36/A 36M and hot-dip galvanized in accordance with ASTM A 123/A 123M. Conduit slots in screw foundation shafts and top plates shall be marked to indicate orientation. Design calculations indicating adequate strength shall be approved before installation of any screw foundation.

3.12 LIGHTING

3.12.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

3.12.2 Fixture Installation

Standard fixtures shall be installed as detailed on Standard Detail No. 04-06-04, Sheet Nos. [_____], which accompany and form a part of this specification. Special fixtures shall be as indicated on drawings. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection of fixtures to any particular manufacturer. Fixtures of similar design, equivalent light-distribution and brightness characteristics, and equal finish and quality will be acceptable as approved.

3.12.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be installed as required for proper installation.

3.12.2.2 In-Line Fuses

An in-line fuse shall be provided for each fixture.

3.12.2.3 Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special type 1.

3.13 TRANSFORMER INSTALLATION

Transformers for lighting fixtures on [aluminum] [or steel] [or concrete] poles shall be installed in the transformer base. A transformer base shall be provided for poles that require transformers. Transformers shall be securely mounted to steel supporting plates and bolted to wood poles.

3.14 LIGHTING CONTROL SYSTEM

3.14.1 Photo-Control

Lighting luminaires shall be [controlled in banks by a single photo-control element mounted within each bank.] [individually controlled by photo-control elements mounted [on] [or] [adjacent to] the heads of the luminaires.]

3.14.2 Time Control Switches

Switches shall be installed with not less than four 6.4 mm (1/4 inch) 1/4 inch bolts. The use of sheet metal screws will not be allowed.

3.14.3 Manual and Safety Switches

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm (1/4 inch) 1/4 inch bolts. The use of sheet metal screws will not be allowed.

3.14.4 Magnetic Contactors

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm (1/4 inch) 1/4 inch bolts. The use of sheet metal screws will not be allowed.

3.14.5 CCTV Alarm Interface

An alarm interface shall be furnished with the lighting control system. The interface shall be compatible with the CCTV alarm annunciation system. The alarm interface shall monitor alarm closures for processing by the system CPU. Alarm inputs to the alarm interface shall be relay contact or through an EIA ANSI/EIA/TIA 232-F interface. The alarm interface shall be modular and shall allow for system expansion. The alarm interface to be installed at the site shall be configured to handle [_____] alarm points, and shall have an expansion capability of not less than [10] [_____] percent. An output shall be provided to actuate a video recorder.

3.15 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following. Grounding conductors shall be soft-drawn, stranded copper. Ground rods shall be driven into the earth so that after the installation is complete, the top of the ground rod will be approximately 300 mm 1 foot below finished grade, except in handholes. [Butt grounds made of at least 4 m 13 feet of No. 6 bare copper wire stapled to the butts of wood poles in spirals may be used where a ground resistance of 25 ohms or less can be obtained by this method.] [Butt grounds shall not be used.]

3.15.1 Ground Rods and Pole Butt Electrodes

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a [driven ground rod] [pole butt electrode] shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, additional electrodes shall be provided [interconnected with grounding conductors] [as indicated], to achieve the specified ground resistance. The additional electrodes shall be [up to three, [2.4] [3] m [8] [10] feet long rods spaced a minimum of 3 m 10 feet apart] [a single extension-type rod, [15.9] [19.1] mm [5/8] [3/4] inch] in diameter, up to 9.1 m 30 feet long, [driven perpendicular to grade] [coupled and driven with the first rod]. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.15.2 Items to be Grounded

Ground conductors, metallic conduits, junction boxes, and noncurrent-carrying metallic parts of equipment shall be grounded. Connections above grade shall be made with solderless connectors, and those below grade shall be made by a fusion-welding process.

3.15.3 Lighting Pole

One ground rod shall be provided at each pole. Bases of metal or concrete lighting poles shall be connected to ground rods by means of No. 8 AWG bare copper wire. Lighting fixture brackets on wood and concrete poles shall be grounded to a No. 6 AWG bare copper grounding conductor connected to the ground rod.

3.15.4 Handhole

In each handhole, at a convenient point close to the wall, a ground rod shall be driven into the earth before the floor is poured, and approximately 100 mm 4 inches of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor, and a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall. Connection to ground rods shall be by means of bolted-clamp terminals or by an approved fusion-welding process. Ground wires shall be neatly and firmly attached to handhole walls, and the amount of exposed bare wire shall be held to a minimum.

3.15.5 Metal Cable Boxes

Metal cable boxes for direct-burial cable shall be connected to adjacent ground rods by wires with current-carrying capacities of at least 20 percent of the spliced phase conductors, but not less than No. 6 AWG.

3.16 TESTS

3.16.1 Testing For CCTV Assessment Lighting

The Contractor shall perform site testing and adjustment of the completed CCTV lighting. The Contractor shall perform the CCTV lighting testing in conjunction with Section 16751 CLOSED CIRCUIT TELEVISION SYSTEMS. The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test; notice shall not be given until after the Contractor has received written approval of the specific test procedures. Test procedures shall explain, in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. Test reports shall be used to document results of the tests. Reports shall be delivered to the Government within 7 days after completion of each test.

3.16.2 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power.

3.16.3 Ground Resistance Measurements

The resistance to ground shall be measured by the fall-of-potential method described in IEEE Std 81.

The contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the lighting to be used for "as-built" drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the lighting system. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Upon completion of the as-built drawings, a representative of the Government will review the as-built work with the Contractor. If the as-built work is not complete, the Contractor will be so advised and shall complete the work as required.

-- End of Section --



Field Maintenance

A Basic Guide for Baseball & Softball Fields of All Levels

This publication is provided by the Baseball Tomorrow Fund, a joint initiative of
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Preface

The information in this document is provided as a general reference guide for the maintenance of a baseball or softball field or facility. Professional and international baseball and softball federations and organizations follow similar guidelines pertaining to the dimensions and needs for field development. The information provided in this document should be used only as a resource in the development of a playing field; this information does not represent the only means and methods of field development.

This document is a summary comparison of field establishment processes. These findings may illustrate potential solutions for construction, maintenance and safety for the field of play; however, all areas regarding potential field development may not be identified in this document.

Please note that certain country or regional laws and standards may apply to the construction of athletic fields. Therefore, the guidelines found in this document do not imply that a specific field does not comply with worldwide baseball standards. This document was written in 2006 and updated in 2012.

About the Authors

Murray Cook, President of Brickman Sports Turf and field consultant for Major League Baseball, has over 30 years of experience in the management of professional, collegiate and youth baseball fields worldwide. Mr. Cook, in collaboration with the Baseball Tomorrow Fund (BTF), created this document to provide a resource for baseball field development and field maintenance for organizations involved in all levels of the game.

BTF is designed to promote the growth of youth baseball and softball throughout the world by awarding grants to support field renovation and construction projects, equipment and uniform purchases, coaches training material and other selected program expenses. Since its formation by Major League Baseball and the Major League Baseball Players Association in 1999, BTF has awarded more than $20 million to non-profit and tax-exempt organizations in the U.S., Canada, Latin America, the Caribbean, Europe and Asia. The Baseball Tomorrow Fund also established national programs encouraging equipment donations and field maintenance education across the Major Leagues.

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Chapter I - Field Maintenance

Developing a Field Maintenance Plan

Providing adequate field maintenance is the key to a safe and quality baseball and softball program and facility. Significant time and resources are required to maintain a field properly. Developing a feasible field maintenance plan is a very important part of any baseball or softball program.

Planning

To develop a field maintenance plan, determining answers to the following questions during the planning stage of a renovation or new construction project is critical:

- What organization will be responsible for maintaining the field?
- What experience, expertise and equipment are available?
- What is the annual field maintenance budget?
- What are the funding sources to sustain the annual budget?
- Will the field be used for other sports or events?
- How many games will be played per day, week, month and year?
- Will the field be a site for tournaments?
- Should the field have synthetic or natural turf?

Staffing

While professional fields are often maintained by a full-time staff, recreational and youth fields often require volunteer help. Providing basic field maintenance checklists to coaches, players and volunteers can ensure proper maintenance of the field. Basic checklists that can be used a starting point can be found in Chapter V. Once a checklist is developed, it can be laminated and posted in each dugout for the reference of all coaches and players.

Budget

The average, annual field maintenance budget for a professional field can range from $50,000-200,000. Similarly, maintenance budgets for recreational and school fields will vary widely. Important budget considerations include: competitive level of use, condition of the field, type of field (i.e. natural or sand-based, type of grass, artificial turf), use of the field for other activities and the availability of field lighting. To develop an annual budget, investigate similar, well-maintained fields in the community and inquire about the maintenance budget, equipment and staffing.

Suggested Maintenance Equipment

Many pieces of equipment are considered necessary to provide adequate field maintenance. This list provides a snap shot of the tools and equipment used by groundskeepers for the maintenance of a field. Descriptions of several key equipment items follow.

Tools and Equipment

- Batter's box, baseline chalker
- Base hole covers
- Batter's box and catcher's box outline frames
- Push broom
- Drags (assorted)
- Edge cutter
- Line marker
- Mound and hitting mats
- Rakes (assorted)
- Shovels
- Small backpack-style sprayer
- String line
- Tamp
- Tarpaulins
- Watering equipment - hoses, spray nozzles, sprinkling (watering) can
- Wheelbarrow









Materials

- Calcined clay - granulated
- Diamond dust - ground calcined clay - for drying wet balls
- Fertilizers
- Herbicides and pesticides
- Line marking material
- Stockpile of mound clay – approx. 2 tons per field
- Stockpile of soils for fill and topdressing – approx. 25 tons per field

Rakes

Each field should have an assortment of rakes. Two each of the following rakes are suggested:

Type of Rake	Suggested Use
Board or Smoothing Board Rake	For smoothing the clays.
Garden Rake	For deeper raking to dry areas and to mix materials into the clays.
Fan or Leaf Rake	To rake clay and soil from the edge of the grass after each game. The best fan rakes are made of plastic. Metal fan rakes are not recommended.

Mound and Home Plate Compactors, Rollers and Tamps

A "hand" tamp (below left and center), is a rectangular piece of iron measuring 6" x 8" x 1 ½" welded to a 4-foot length of 1 ½" pipe. A tamp is used to pack the clays around the pitcher's mound and home plate area. A roller (below, right) is also used on the infield skin (dirt area.)





Cover the bottom of the tamp with a piece of burlap. Tie the ends of the burlap around the handle of the tamp. This will reduce the sticking of moist clays to the tamp.

Drags





A drag is used to smooth the skinned areas of the infield. Various models of drags are available. The three types of drags are shown in the photo, top left (from top to bottom): nail, steel and cocoa mat. Some drags are built from steel mesh. Some drags used for finishing the field are made from cocoa mats. This natural fiber ensures a smooth appearance.

A nail drag is used to scarify, or loosen, the skinned areas of the infield. A variety of nail drags are available from baseball equipment retailers; however, to cut costs, a simple nail drag can be easily constructed (see steps below.)

A drag can be pulled by hand or attached to the back of a vehicle and pulled. Some motorized maintenance vehicles come equipped with dragging implements.

It should be emphasized that the drag should not overlap the turf. If overlapping does occur, a dangerous "lip" of built up dirt will occur at the edge of the grass area. The drag should always be picked up and carried away and never dragged across the grass area.

How to Make a Nail Drag

Materials Needed:
5 – 2 X 4 in. wood boards, each 3 ft. long
5 – 1 X 4 in. wood boards, each 3 ft. long
100 metal spikes
4 eye bolts
20 ft. of nylon rope or link chain
Hand saw, power drill, hammer

Construct a 3 X 3 foot frame using five, 2 X 4 inch wood boards. The corners and the ends of the center board are dovetailed, or slotted together, to allow the frame to lie flat. Staggered holes are drilled (slightly smaller than metal spikes) through the board approximately 1 inch apart. The metal spikes are then driven into the holes. A frame is attached by nailing a 1 X 4 inch board to cover the nail heads to prevent them from coming out. Attaching an eye bolt in each corner of the board, a rope or link chain is attached to drag the spiker in either direction. When more weight is needed to loosen more compacted surfaces, cement blocks or other weights may be placed on top of the drag.

Tarpaulins



Photo by Brickman Sports Turf Division

Tarpaulins, also known as tarps, are used for several purposes including: to protect the field from rain, to retain moisture in the mound and home plate areas when the field is not in use and to protect the turf during practice (photo below.)

In the event of rain, the mound and home plate areas should be covered as quickly as possible. A heavy plastic cover, at least 6 mm in thickness, or nylon cover is suggested. The tarp should be as heavy as possible to keep the tarp on the ground during high winds. The tarp should be large enough to just overlap the grass by approximately 8 inches.

A tarp that covers the entire infield is also available, as shown in the photo above. This tarp is usually made of the same fabric and measures approximately 165 ft. by 165 ft. The folding and rolling of the tarp can be difficult and should be consistent to cover the field as quickly as possible when it is raining.



Kits with smaller tarps to cover the pitcher's mound, home plate area and base positions are also available.

Tarps are used to maintain moisture in the pitcher's mound and home plate areas. **The use of tarps is recommended anytime the field is not in use.**

How to Mow a Field

The mowing of the infield and outfield turf should be completed based on the grass growing heights. A rule of thumb is mow no more than one-third of the blade of grass at any given time. Mowing the grass more than one-third at a time can result in discoloration or "scalping" of the turf, or cutting the turf too low. The following chart provides the suggested heights of common types of grasses:

Type of Grass	Best Height
Bluegrass	1-1 ½ in.
Tall fescue	2 in.
Zoysia	½ - 1 in.
Bermuda	½ - 1 in.

Turf Mowing Maintenance



There are two types of mowers available to cut the field: 1) rotary, and 2) reel mowers. The most common type of mower is a rotary mower. Rotary mowers are used primarily on residential lawns.

Reel mowers are more specialized and are used on higher maintenance facilitates like golf courses and athletic fields. These mowers require additional training to operate properly. Reel mowers are used to provide better quality cutting and allows very low cutting heights. These mowers also have striping capabilities, as shown in the photo above.

The number of times per week the field is mowed will vary depending on the budget, weather and fertility program. Baseball fields are mowed everyday to once a week, depending on the specific needs and standards of the facility.

When mowing a baseball field, keep in mind the following items:

1. It is important to train employees on equipment to reduce the potential for damage and ensure safety.
2. Check oils and lubricate the equipment prior to mowing. Proper equipment maintenance is critical.
3. Always use sharp blades and/or adjust reels prior to every mowing.
4. If the mower makes turns on the skinned areas and warning track, remove any clippings on those areas.

5. Mowing the field when wet is not recommended and should be avoided whenever possible.

There are four traditional patterns to mow a baseball field:



Home Plate to First Base



Home Plate to Third Base



Home Plate to Second Base



Foul Pole to Foul Pole and the Infield Arc

Above photos by Brickman Sports Turf Division

Mow no more than one-third of the blade of grass at any given time.

How to Maintain the Base Paths

It is best to maintain as much of the base paths by hand as possible. Use a drag that is narrower than the width of the base paths. Make sure that the drag does not overlap the grass area to prevent the formation of a "lip" or ridge at the edge of the grass.

Prior to raking the base path, remove any white chalk material with a shovel. This will keep the clay more stable and not cause a hump, or raised area, down in the middle of the baseline.

Rakes should also be used on the base paths. When raking the base paths, do not rake across the path, but go up and down the baseline. Raking across the path can cause a low spot to develop down the middle of the path.



Weeds in the base paths (photo, right) should be removed by hand.

When raking the base paths, **do not rake across the path**. Rake up and down along the length of the path.

📖 **Infield Skin** – the areas on a field composed of clay, such as base paths, pitcher's mound and home plate area. These areas are composed of **infield mix**, also called **infield clay**.

How to Maintain the Infield Skin



The following is a suggested method to properly maintain the skinned areas of the infield:

1. Rake excess dirt from underneath each base area to make it level.
2. Remove any debris, including grass clippings, rocks, weeds, etc.
3. Water the skinned area to allow the infield to be nail dragged. If the skinned area is already moist, this step can be skipped.
4. Nail drag the infield.
5. Add soil conditioner (shown above) and spread with a rake.
6. Screen or drag the infield.
7. Water infield as needed to ensure desired moisture levels.

While maintaining the infield, the drags should be kept at least 6 inches away from the grass so that the loose dirt does not get into the grass thus forming a "lip," or ridge, in the grass edge. A regular rake should be used along the grass edge. Should dirt get into the grass edge, a stiff brush broom should be used to "sweep out" the dirt back onto the skinned area, removing any grass clippings that may be swept onto the skinned area in the process.



Anytime a "lip" begins to develop where the grass and dirt area meet, use a water hose to wash the dirt out of the grass and back onto the skinned area.

To drag the infield skinned area, make a spiralling circle with the drag mat from the infield grass line to the outfield grass, starting at the third base foul line, across the skinned area to the first base foul line. This circular spiral should measure 9-10 ft. in diameter.



Edging the field (photo right) should be done on a bi-weekly basis during the growing season. This will greatly reduce built-up edges. Always use a string line when edging the turf, as shown above.

How to Maintain the Pitcher's Mound, Home Plate and Bullpen Areas



During every game, damage occurs to the pitcher's mound and home plate areas. Regular, proper maintenance will reduce time and money needed to rebuild and renovate these areas. It is also critical to maintain these areas properly to reduce the potential for injury.

The following is a suggested method to properly maintain the pitcher's mound and home plate areas on the field and in the bullpen areas:

1. Sweep debris material from the landing area and table of the mound. This allows the packing clay to be exposed. The landing area is the location on which the pitcher steps to pivot and throw. The table is the area at the top of the mound, measuring 36 inches by 5 feet.
2. Tamp any uneven packing clay level prior to watering.
3. Using a small roller can provide consistency in the mound and home plate areas.
4. Lightly moisten the clay to ensure new packing clay will bind to the existing clay.
5. Scuff-up, or loosen, damaged areas with a shovel.
6. Add new packing clay to the damaged areas.
7. Tamp newly installed packing clay into the ground.
8. Rake down the newly repaired areas.
9. Rake all debris from the pitcher's mound.
10. Add soil conditioner (if needed.)
11. Water the entire pitcher's mound.
12. Allow the mound to dry; however, do not allow the packing clay to dry too much to the point of cracking.
13. Once the pitcher's mound is completely prepared for the game, cover it with a tarp to maintain a proper moisture level. Repeat this process for the home plate, mound and in the bullpen areas.



In some cases, clay bricks are used to establish a firm throwing area. The photo (left) shows the use of moist clay bricks for the home plate area. These bricks are a very acceptable material because they have not been hardened by heat, like bricks used in construction.

Chapter II - Turf Management

Control of Weeds, Pests and Disease

The turf on the field of play must be protected from weeds, pests and disease. There are recommended chemicals that have all been tested. Many new types of chemicals are entering the market regularly and it is important to determine if the geographical area allows specific types of chemicals to be applied.

The products noted in this section are suggestions only. The type of weed control selected should be determined based on the field conditions and level of weed growth.

For broad leaf weeds such as dandelion, ground ivy, plantain and buckhorn, the types of herbicides used across the industry varies. Pre-emergent herbicides are applied in mid-spring, and post-emergent herbicides are applied in the fall. It is suggested that these products should not be used in hot weather because it may cause discoloration.

Pre-emergent herbicides have been effective for grassy weed control such as crabgrass. Treflan, Daethal, Bandane, and Zytron are pre-emergent herbicides.

For control of different types of cut worms and beetles, turf managers have used products such as Heptachlor, Chlordane, Adrin, and Malathion. Each one is different and the exact material will be recommended by the testing lab chosen as a source to determine fertilization needs. All products should be watered in immediately after application. Follow the manufacturer's label of the product closely.

It is important to remember that some bugs are our "friends" when it comes to growing healthy turf. Earthworms and beetles aerate the soil and create organic matter. Bugs are beneficial in many areas of our world; however, on a professional level baseball field, an infestation of bugs can cause slight undulations in the finish grade.

Environmentally-safe methods of weed control, such as pulling weeds by hand, should be considered whenever possible. If weed control products with chemicals are used, appropriate measures regarding the use of fields should be established to ensure safety.

Aeration

High-use areas on a field require aeration. To aerate is to provide ventilation, or expose air, into the soil. The greater the use of the field (or specific area of the field) the more aeration is needed.

To aerate the field, a machine is required to remove small cores of the turf. Aerating machines are sometimes mechanical devices pulled behind a cart or vehicle. The mechanical, self-propelled type of aerating machine is highly preferred.

Aerate **at least 2-3 times per year**.

There are several types of aeration. The type selected is based on the time of season and the specific issues to be addressed with the soil. The types of aeration include: hollow tine aeration, solid tine, open tine, slicing tines, water jet, and event deep tine. A tine is a spike: the pointed part of the aeration machine that is driven into the soil or turf. Some aeration machines mechanically drive the tines into the ground. Other aeration machines pull the tines across the field, while the tines penetrate the soil based on the weight of the machine. Most turf managers prefer the mechanical approach. The mechanical machines provide a more even distribution of aeration allowing the depth of the tines to remain constant.

On average, natural soil fields require more aeration than sand-based fields due to compaction issues. The amount of aeration depends on the use of the field. It is recommended to aerate at least 2-3 times per year.



Photo by Brickman Sports Turf Division

After the field is aerated, it is also recommended to top dress the field. Topdressing is applied with a machine pulled behind a cart, as shown in the photo (left.)

On Bermuda turf, the field should be verticut to remove the thatch layers. The verticut process uses a power machine with vertical blades to remove the thatch and allows the turf to grow properly. This procedure should be completed at least once per year. On Bluegrass or cool season grasses, the process of verticutting or de-thatching is required; however, all efforts should be made to perform this procedure in the fall. In addition, good judgment must be used to determine the depth of the dethatcher so that the root structure is not removed or damaged in the process. Following the removal of the thatch on Bluegrass turf in the fall, the field should be over-seeded and top dressed.

Renovation vs. Reconstruction



Photo by Brickman Sports Turf Division

When determining whether to renovate or reconstruct a field, the rule of thumb is as follows: "Reconstruct if the turf has more than 50% weeds with a large proportion of crabgrass or, if in the north, poa trivialis." In other words, renovate the field if it has less than 50% weed infestation. However, this decision also depends on the type of weeds present and location of the field.

If total reconstruction is chosen, fumigation of the field to kill off the weeds properly may be necessary. If only a slight renovation is chosen, plan to aerate, top dress with sand, fertilize, overseed or sod and water adequately to obtain proper growth. Renovation may be necessary in small sections. Be sure to match the seed or sod to existing materials to avoid a "patch" look in the spring when the turf grows in. In most areas, the best time for either renovation or reconstruction is autumn.

Grass Selection

Selecting the type of turf needed is partially determined by geographic location. Fields located in northern U.S. use cool season turfs such as Bluegrass, fescues and rye grasses. In the southern U.S., Bermuda-type turf and Zoyzias grasses are commonly used. In Europe, Pos type turfs are used. Determining the best grass for the area is as simple calling the local agricultural or agronomic school. Thousands of varieties of grasses are available, but all grasses can be categorized in the groups noted above. No one type of grass is perfect, but there are some excellent grasses adapted to fit nearly all conditions.

The **best time to renovate or reconstruct** a field is autumn. Call the local agricultural or agronomic school to determine the best type of grass for the area.

Irrigation





All turf will need water, or irrigation, for establishment, growth and repair. If nature does not provide rain in sufficient amounts, the turf manager must provide the water. The ability to have a consistent water supply is critical to field maintenance. **Installing an automatic irrigation system should be one of the highest priorities in any field renovation or construction.** Watering thoroughly to allow the water to soak deeply is required. Deep watering encourages deep root growth. Frequent shallow watering encourages shallow surface roots, compactions, crabgrass and other weeds.

Some engineered soils can hold up to 1,000 gallons of available water per 1,000 square feet to a depth of 6 inches. Under severe drought conditions, the turf may lose a quarter to a third of an inch of water per day.

It is possible to over water a field. Grassy weeds such as nut sedge may appear. Over watering also limits the oxygen supply to the turf and may cause yellowing which can create turf that is susceptible to disease.

A soil probe should be used to check the depth of moisture saturation. A soil probe can be purchased from local lawn and garden stores. It is a very valuable tool used to pull small cores of soil from your field to check root depth and moisture. If the penetration is slow, aerating may be necessary because the soil is compacted. Frequent use of the aeration equipment will keep the soil open and provide the necessary porosity, or porous quality of the soil.

In addition to the maintenance of the infield and outfield turf, **irrigation is also necessary to properly maintain the infield skin, pitcher's mound and home plate area**. The application of water is essential to effectively work with infield mix and mound clays.

Deep watering encourages healthy turf.
Frequent shallow watering encourages crabgrass and weeds.

Fertilization



Photo by Brickman Sports Turf Division

Turf must have the following nutrients in order to grow and heal after wear and tear: nitrogen, phosphorous and potassium. **The formula for the accurate amounts of these products should be determined by having a soil analysis completed by an agronomic agency specializing in the evaluation of athletic turf grasses.** All athletic turf should have an application of a complete balanced fertilizer throughout the year.

The chart below provides several types of balanced formulas, depending on local soil conditions.

Nitrogen %	Phosphorous (Phosphate) %	Potassium (Potash) %
10	10	10
15	5	15
10	5	5
8	6	4

Nitrogen is a main staple for leaf growth and is supplied in either organic or inorganic form. The organic type is also available in sewage sludge, cottonseed meal and urea form. The inorganic is available as sulphate of ammonium, urea or ammonium nitrate. Sport turf managers use both organic and inorganic blends. This produces a more uniform and steady grass growth.

A general rule of thumb is to provide ½ to ¾ pound of nitrogen (actual) per 1,000 square ft. during each month of the growing season. In most sports field environments it is better to feed lightly and frequently. A consistent supply of nitrogen will provide for steady growth and recovery from injury and wear. In contrast, too heavy of feedings may create a tender, even slippery turf that has a lower tolerance for wear. Again, perform soil and tissue tests regularly, approximately 3 to 4 times per year. Bermuda and Zoysia grasses should be fed regularly during the long summer growing season.

Soils in the cool temperature areas, which are northern hemisphere, require different fertilizers than those in the south. The area separating the two hemispheres is called the transition zone. The transition zone is the area located between cool season grasses and warm season grasses. Growing turf in the transition zone is very difficult as neither variety of grass is ideal. Therefore, consult a local agricultural/agronomic school for the appropriate types of fertilizers for the area.

Using a cyclone, walk-behind fertilizer spreader is preferred by most sport turf managers. Determine if the grass is dry before applying a fertilizer. It is considered a good practice to aerate the area before applying fertilizers. Afterwards, the soil should be dragged and watered to insure the chemicals get to the roots. Under normal conditions, ground limestone should only be needed every other year.

Healthy turf needs nutrients such as nitrogen, phosphorous and potassium. For sports fields, it is better to **fertilize lightly and frequently**.

Chapter III - Field Equipment

The following equipment and field elements are necessary to meet the general requirements of the rules of baseball and the minimum standards used by the International Baseball Federation. Numerous variations of equipment are used, but this section may assist the understanding of the level of detail needed at the field to host a tournament or higher level of competitive play.

Field Lighting



When considering field lighting, remember that the addition of field lighting will result in greater usage of the field and more time and funding required for on-going field maintenance and renovations. However, if field usage is managed properly, with time allowed during the season to rest the field, field lighting can be a useful addition to the field and the programs that utilize the field. If funding allows, the installation of field lights (or the required electrical infrastructure for the future installation of field lights) during the initial field construction stage is highly recommended.

When planning the installation or replacement of field lighting, it is important to understand that each level of play requires different levels of lighting requirements; therefore, several factors should be considered. These factors include the size of the facility, the durability of the lighting system, the age of the facility, the requirements of the applicable governing body (i.e. NCAA, IBAF, Little League, Inc., etc.), the potential for televised games or international play. It is important that these issues are discussed with a field lighting professional during the planning process.

To demonstrate the differences in lighting guidelines based on level of play, the following chart provides general lighting guidelines for various levels of fields.

General Lighting Guidelines Based on Field Level

Field Level	Horizontal Illumination Foot-Candles (Lumens)*	
	Infield	**Outfield**
International/Olympics	150 (1,500)	100 (1,000)
Minor Leagues – AAA and AA	100 (1,000)	70 (700)
Minor Leagues – A and Rookie	70 (700)	50 (500)
College – non-televised	70 (700)	50 (500)
College – televised	100 (1,000)	70 (700)
High School, Youth (competitive)	50 (500)	30 (300)
Recreational	30 (300)	20 (200)

** Please note: In the U.S., lights are measured by the amount of Foot Candles (FC.) In Europe, lights are measured in Lumens (Lux.)*

Bases



Each field will need three bases, three base plugs and a clean-out tool to clear any soils that may enter the base anchors. First, second and third bases are 15 inches square, and cannot be taller than 3 inches.

The "Hollywood-Style" base (photo above) is the accepted base for baseball fields throughout the U.S. This style of base is tough, durable, convenient to handle and can be permanently located on the field. There is no slipping of the base, which makes it very safe. The base can be cleaned and painted prior to each event to provide a professional appearance to the field. This type of base does not require spikes or straps. Strap down bases have been ruled as unsafe in some tournaments.

Pitching Rubber



The pitching rubber, also referred to as a pitcher's plate, is available in several styles: four-sided (left), spiked, moveable and step-down. The official size of the pitching rubber is 26"x 6."

Backstop



The backstop is constructed with chain link fencing or with nets and cables. The height of the backstop can range between 10-20 feet and is determined by the age groups served and level of competition played at the field. Selecting the proper height and width of the backstop is important to provide adequate player and spectator safety.

The backstop should be located 60 feet from home plate on regulation baseball fields and 25-35 feet on youth baseball fields.

Backstop netting, which is preferred for higher level and competitive fields, is suspend between the dugouts and normally covers an area directly behind home plate that is 80 feet wide and 24 feet high.

Consult an architect to design a backstop system that bests suits the needs of the facility.



Dugouts







Dugouts are used to protect the players from inclement weather and the sun and to provide an area where they can rest while the opposing team is in the field. Typical dugout structures should be designed to hold a roster of 20 players plus coaches. This would require a dugout to be at least 60 feet long.

Some dugouts are totally enclosed while some may have a low fence in front of the dugout, which is highly recommended. This will help to protect the players in the dugout from foul balls and thrown bats. Some dugouts are sunken into the ground by 2-4 steps. This is not required but does provide a more traditional setting. The dugout can be built at field level. The floor of the dugout should be covered with some type of rubber material to provide safe footing to players wearing metal cleats.

The installation of bat and helmet racks in the dugout is also helpful to extend the life of the equipment and increase player safety.

Coaches' Boxes



There are two coaches' boxes on the field: one for third base and one for first base. The coaches' boxes are marked with a white line. It is better to paint this line than use white chalk or lime. The first and third base coaches stand in these areas. The box is located 15 feet from the foul line in foul territory. The box is 20 feet long and the sides of the box are 10 feet long. The box is sometimes closed in the back, toward the baseline fencing.

Outfield and Baseline Fencing





Chain link fencing is often used to enclose the "perimeter of the field of play" on youth, school and recreational fields. For higher levels of play, the outfield fencing may be made from metal sheets or wood and is padded with 3-inch thick foam. This provides the player with a sense of security allowing him or her to pursue difficult plays without the threat of being injured.

Baseline and outfield fencing is recommended. A field that is completely enclosed by fencing also facilitates on-going maintenance by discouraging or limiting the use of the field for activities that may be harmful to the turf.

The average height of the perimeter fencing is 8 feet; however, 4-6 foot fencing is often used on recreational fields. The age group served by the field, player safety and field security should be considered when determining the appropriate height of the outfield and baseline fencing.

Protective fence cap (photos above) is also installed on chain link fencing for player safety. This product is made of plastic and is attached to the top of the fence. **All unattached or curled chain link fabric should be reattached to the rails or replaced promptly to ensure player safety.** A bottom rail on chain link fencing is recommended to secure the fabric of the fencing.

Other elements related to the outfield fence include the batter's eye, the warning track and foul poles.

Batter's Eye



One of the key components of the outfield is the size and location of the batter's eye. The batter's eye is what the batter sees behind the pitcher. This area must be one consistent, dark color, preferably black, and is

normally 60 feet wide and 30 feet high. It is generally a metal structure covered in wind screen material. The wind screen material is made with a solid mesh-like material which allows some air to flow through it.

Warning Track

The **warning track should extend around the entire field** to provide player safety and to reduce wear of turf in front of the dugouts and around the home plate area.





The warning track can be made from a variety of materials. It can be made of a rubberised material and poured onto asphalt or constructed using red crushed brick material and or shell rock. The goal is to ensure the warning track material is different in color and texture than the playing field surface. It is also important that the warning track material is a stone or aggregate material that is consistent in size and meets certain specifications. For example, stone used in warning track material should be no larger than 3/8th of an inch, as shown in the photo (left).

The depth of the warning track material and the method it is applied will vary depending upon the type of material. On average, approximately 4 inches of material is required over a stable sub base. The warning track is normally 15 feet deep in front of all obstructions; however, consult the leagues and associations that will utilize the field regarding rules and regulations. For instance, the outfield warning track on an Olympic field is 20 feet wide as opposed to a Major League field, which requires a width of 15 feet.

Foul Poles



Foul poles indicate the foul territory of the outfield field. However, despite the name, a ball hitting a foul pole is considered fair. These poles are normally 30 feet high and have 2 foot wing attached to the fair side of the pole. The proper location of each foul pole is identified by using a transit to find a perfect 90 degree angle with the apex of home plate. Each foul pole will be inside this angle, in the left and right field corners of the field. Poles are located off the field of play and behind the outfield fence. In some cases, the foul poles are a part of the outfield fencing and are padded for player safety.

Scoreboards



Scoreboards are available in many different styles with a variety of functions. Before purchasing a scoreboard, consider the following questions:

1. What is the budget to purchase a scoreboard; what will be the budget for on-going operation and maintenance?
2. What are the field dimensions; what size scoreboard is needed for adequate visibility?
3. What levels of games are played at the field (i.e. recreational, competitive, youth, high school, tournaments)?
4. What is the power/utility availability and requirements for the scoreboard?
5. Will the scoreboard be used for sponsorship opportunities, advertisements?
6. Who will operate the scoreboard?
7. Should the scoreboard be permanently installed or portable (for use at multiple fields)?
8. Where will a portable scoreboard be stored, secured?
9. What is required to install the scoreboard; who will complete the installation?

Protective Screens

The purpose of protection screens is to provide protection to players during training and pre-game practices. Protective screens are not used during the game. The following protective screens are recommended:

1. Pitching protection screens – also known as L-Screens – 1 per field
2. First base protection screen – 1 per field
3. second base protection screen – 1 per field
4. ball shagger screen – 1 per field
5. For batting tunnels, one L-screen per tunnel is recommended.

Pitcher's Protection Screen



Photo by Brickman Sports Turf Division

During batting practice, the pitcher is normally throwing from a shortened distance (10-15 feet shorter than regulation, in front of the pitchers mound.) This places the batting practice pitcher in great danger as his reaction time to protect himself is greatly reduced. Therefore, a pitcher's protection screen is highly recommended.

The size of this screen varies for a regulation screen with 2-inch aluminium tubing designed in an "L" shaped is recommended. The recommended dimensions are 8 feet wide with an overall height of 8 feet with the lower wing 40 inches high. The screen should be covered with a strong baseball batting cage-type netting made from nylon if possible. Metal fencing can be used; however, this type is not preferred due to the damage caused by batted balls.

First Base Screen



First base screens, like the one shown on the left, also should have framework of either 1-inch pipe or 2-inch aluminium tubing. The recommended dimensions are 8 feet wide with a height of 8 feet. Again, the screen should be covered with a strong baseball batting cage-type netting made from nylon if possible. Braces can be welded (attached) to the bottom pipe to help the stability of the screen. Wheels can be attached to allow for easier handling.

Second Base Screen and Shagger Screen

Second base and shagger screens are identical and are normally 12 feet wide and 8 feet tall. Construction is similar to the first base screen. It is used to provide protection to the second baseman and shortstop as they practice double plays. The other screen serves a similar purpose as it is used to protect the "ball shagger," who is located behind the second base area during practice.

Portable Batting Cages





A portable batting cage structure is normally 10 feet high, 20 feet wide and 20 feet deep. It is igloo-shaped (or arched) and is constructed with 2-inch aluminium tubing covered with foam padding for safety of the players inside the batting cage. The structure is usually built with three wheels. One wheel swivels to direct the cage and the other two are stationary. The cage is rolled and positioned very close to the field turf with no more that 3 inches between the lower rail and the grass; therefore, moving it across the field requires a smooth access on and off the field of play.

Batting Tunnels





Batting tunnels, or batting cages, are often used when the field is too wet for practice or to provide additional hitting practice. The average tunnel is 18 feet wide and 80 feet long and 10 feet high. Some batting cages are suspended by cables; although, many batting cage structures are supported with aluminium tubing. If using aluminium tubing, the tubing should be covered with foam padding for safety. The netting on batting tunnels is similar to that used on portable batting cages. The cage netting behind the batter requires a much heavier nylon or a pad to stop the thrown or fouled ball during practice sessions.

Field Signs

Field signs are used for many purposes: to provide the field dimensions (distance to the outfield), to provide sponsorship (fundraising) opportunities, etc. However, field signs can also help encourage good field maintenance practices by all coaches, players and the public.









Chapter IV – Softball Field Maintenance



The maintenance of softball fields is very similar to baseball fields. Although similar, there are several issues regarding the maintenance procedures of infields, mounds and plate areas that vary.

Photo by Brickman Sports Turf Division

1. A softball field is predominately flat with a 1% grade, falling from the center of the mound. Due to the large area of clay, the infields require extensive dragging and shaping to reduce low spots.

2. The pitcher's mound is flat and requires similar maintenance as a baseball mound such as watering the clays and packing the mound after use.

3. The home plate area is also treated the same as on a baseball field, as softball and baseball players dig similar holes during the course of play. Follow the same maintenance procedure for the home plate, mound and infield areas.

4. The field layout is different for softball fields for varying ages. Please see Chapter V for suggested field dimensions.

5. The depth of a warning track on a softball field is normally 10 feet.

6. Due to the large size of the softball infield, irrigation systems are installed to irrigate the infield clays. An automatic irrigation system will allow more time for the ground crew to focus on the mound, home plate and dragging requirements.

Chapter V - Resources



In this chapter, the following information is provided for reference:

- Suggested Field Dimensions
- Diagrams of Field Layouts
- Metric Conversion Chart
- Daily and Annual Field Maintenance Checklists

  Checklists can be used as a helpful guide to develop a proper maintenance routine, especially when several persons or organizations are involved in the maintenance of the field. These checklists can be modified to meet the specific needs of each field. Post the checklists in each dugout for reference by the grounds keeper, coaches and players.

Suggested Field Dimensions

Baseball

Age Group	Left Field	Center Field	Right Field	Pitching Distance	Distance Between Bases
Ages 17 and older	321 ft.	400 ft.	321ft.	60 ft. 6 in.	90 ft.
Ages 15-16	280 ft.	350 ft.	280 ft.	60 ft. 6 in.	90 ft.
Ages 13-14	250 ft.	315 ft.	250 ft.	54 ft.	80 ft.
Ages 11-12	200 ft.	200 ft.	200 ft.	46 ft.	60 ft.

Girls' Fastpitch Softball

Age Group	Home Run Fence	Pitching Distance	Distance Between Bases
High School (NFSHSA)	185-235 ft.	40 ft.	60 ft.
Ages 15-19 (ASA)	200-225 ft.	40 ft.	60 ft.
Ages 14 and under (ASA)	175-200 ft.	40 ft.	60 ft.
12 and under (ASA)	175-200 ft.	35 ft.	60 ft.
10 and under (ASA)	150-175 ft.	35 ft.	55 ft.

Suggested Space Requirements

Field Dimension	Age Group	Space Requirement
Regulation baseball (90 ft. bases)	High school level and 16 year olds and up	110,000 sq. ft.
Regulation baseball (90 ft. bases)	13-15 year olds	90,000 sq. ft.
Youth baseball (60 ft. bases)	12 and under	60,000 sq. ft.
Fastpitch Softball (60 ft. bases)	12 and under to 19	60,000 sq. ft.

Metric Conversion Chart

LENGTH				
Symbol	**When You Know**	**Multiply by**	**To Find**	**Symbol**
in	inches	2.54	centimeters	cm
ft	feet	30.48	centimeters	cm
ft	feet	0.3048	meters	m
yd	yards	0.9144	meters	m
mi	miles	1.6097	kilometers	km

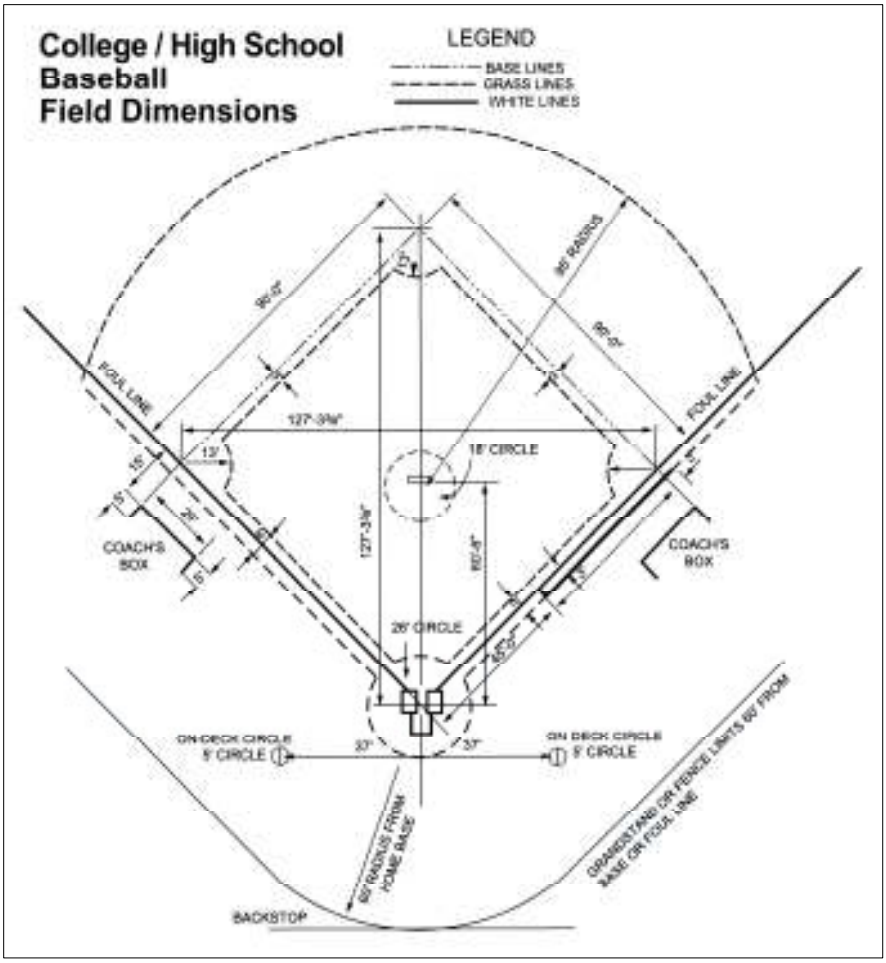
AREA				
Symbol	**When You Know**	**Multiply by**	**To Find**	**Symbol**
sq. in. (in^2)	square inches	6.45	square centimeters	cm^2
sq. ft. (ft^2)	square feet	0.093	square meters	m^2
sq. yd. (yd^2)	square yards	0.836	square meters	m^2
	acres	0.405	hectares	ha

WEIGHT (MASS)				
Symbol	**When You Know**	**Multiply by**	**To Find**	**Symbol**
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg

Diagrams of Field Layouts

(Diagrams from www.markersinc.com)

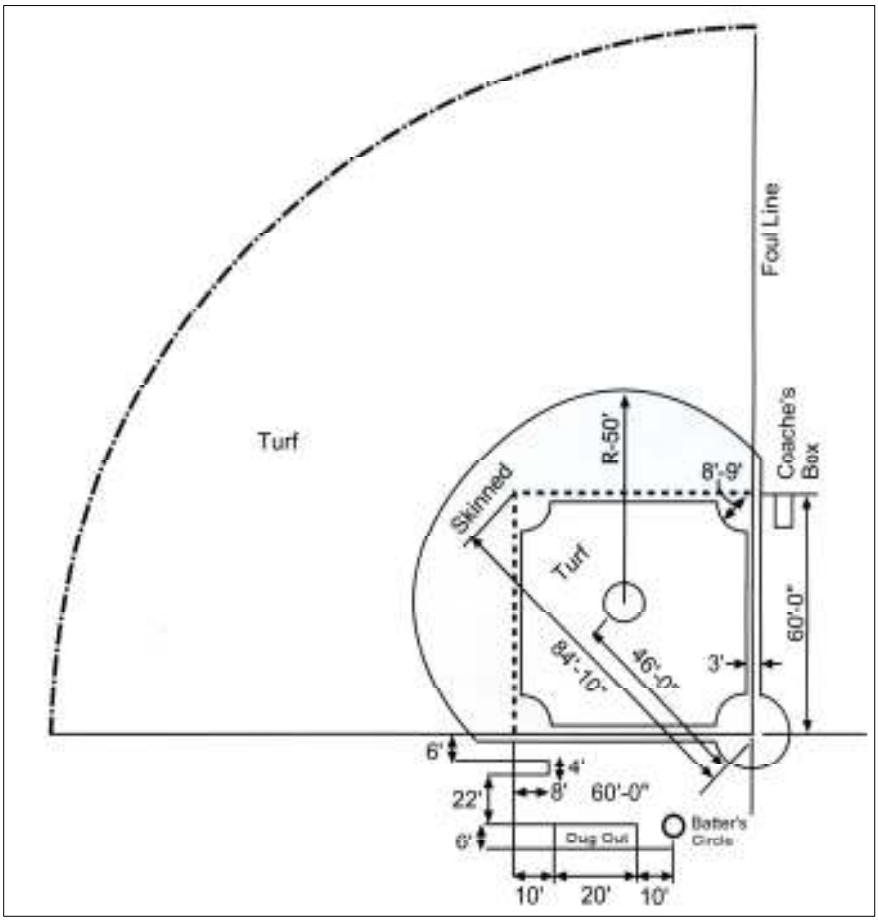
Regulation Baseball Field



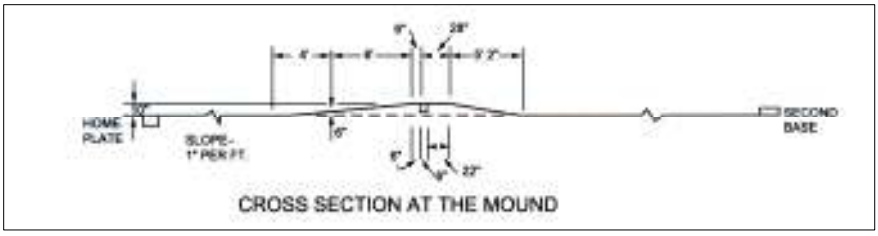
Diagrams of Field Layouts

(Diagrams from www.markersinc.com)

Youth Baseball Field



Baseball Pitcher's Mound



Daily Field Maintenance Checklist

Daily Routine before Practice:	✓
Remove tarps	
Water skinned areas and baselines	
Install the bases	
Erect safety screens for pitcher, first base and second base	
Place the batting cage at home plate	

Daily Routine after Practice and Games:	✓
Remove the bases and cover the base anchor sleeves	
Drag the skinned areas and baselines	
Recondition the mound, home plate area, cover with tarps	
Recondition the bull pen mound and home plate area	
Replace and tamp any loose divots in turf areas	
Dispose of trash in and around field and bleacher areas	

Day of Game Routine:	✓
Remove tarpaulins	
Mow the grass	
Scarify the skinned areas with a spiker	
Drag the skinned areas smooth	
Water the infield area	
Sweep and clean dugouts	
Set the chalk lines and mark officially	
Place the batting practice pitcher's mat on the mound	
Place the safety screens: pitcher, first base and second base	
Paint or wash bases, pitching plate and home plate	
Prepare the bullpens	
Hang flags on the foul line poles and flagpole	
Check the operation of the field lights and scoreboard	
Prepare the press box and operation of the p.a. system	
Check the operation of the electrical equipment in the concession stand	
Clean and prepare the locker rooms and umpire rooms	
Dispose of trash found in and around field and bleacher areas	

Annual Field Maintenance Checklist

Spring Routine:	✓
Perform soil and tissue tests	
Aerate the field	
Top dress the field	
Fertilize the field	
Apply pre-emergent herbicides	
Clean, paint or repair dugouts, fencing, bleacher areas and field signs	
Reattach or replace lose or curled chain link fabric	

Fall Routine:	✓
Perform soil and tissue tests	
Aerate the field	
De-thatch or verticut turf	
Over-seed and top dress the field	
Fertilize the field	
Apply post-emergent herbicides	
Add ground limestone every other year	
Complete renovations or reconstruction projects if needed	

Winter Routine:	✓
Review field maintenance plan and budget	
Review upcoming field use schedule	
Clean, repair or replace field maintenance equipment	
Plan future renovations or reconstruction projects to be completed next fall	

Notes

Important Contacts

Name: _____

Company: _____

Product/Service:_____

Office: _____

Cell:_____

E-mail:_____

Notes: _____

_____

Name: _____

Company: _____

Product/Service:_____

Office: _____

Cell:_____

E-mail:_____

Notes: _____

_____

Name: _____

Company: _____

Product/Service:_____

Office: _____

Cell:_____

E-mail:_____

Notes: _____

_____

ESPECIFICACIÓN DE ILUMINACIÓN
PREPARADA PARA
PARQUE DE PELOTA RECREACIONAL

SECCIÓN 26 56 68 – ILUMINACIÓN ATLÉTICA EXTERIOR

Sistema de iluminación con fuente de luz LED

PARTE 1 - CONDICIONES GENERALES

1.1 RESUMEN

A. El objetivo de de estas especificaciones es definir el desempeño y los estándares de diseño del sistema de iluminación para paraque de Pelota con uso Recreacional utilizando una fuente de luz LED. El fabricante/contratista deberá surtir equipo de iluminación que cumpla o exceda con los estándares establecidos en estas especificaciones.

B. La iluminación deportiva será para los siguientes espacios:

1. Parque de Pelota – Terreno de Juego

1.2 DESEMPEÑO DE LA ILUMINACIÓN

A. Niveles de iluminación y factores de diseño: Las superficies de juego deben ser iluminadas a un nivel promedio de iluminación deseada y de uniformidad que se especifica en la siguiente tabla

Área de iluminación	Niveles promedio de iluminación deseada	Tasa de uniformidad de máxima a mínima	Puntos de cuadrícula	Espaciamiento de cuadrícula
Infield	30 footcandles	2.5:1 Max/Min	25	30’ x 30’
Outfield	20 footcandles	3:1 Max/Min	100	30’ x 30’
Bullpens	20 footcandles	3:1 Max/Min	16	10’ x 10’
Área de calentamiento atrás de homeplate	20 footcandles	3:1	>25	10’ x 10’

B. Color: El sistema de iluminación deberá tener una temperatura de color mínima de 5700K y índice de rendimiento de color (CRI) de 75 CRI.

C. Alturas de montaje: Para garantizar los ángulos apropiados de dirección para reducir el deslumbramiento y ofrecer mejor facilidad de juego, las alturas mínimas de montaje serán descritas a continuación. Podrían requerirse alturas de montaje mayores con base en los reportes fotométricos y la capacidad de garantizar que la parte superior del ángulo de campo esté al menos 10 grados debajo de la horizontal.

D. Debido a la sombra causada por el techo, el diseño lumínico debería usar luminarias montadas en el borde del techo para disminuir la sombra. El diseño lumínico tiene que mostrar el área de calentamiento atrás de homeplate con el promedio y uniformidad mostrada arriba.

No. de postes	Designación del poste	Altura del poste
8	S1-S8	35’

PARTE 2 - PRODUCTO

2.1 CONSTRUCCIÓN DEL SISTEMA DE ILUMINACIÓN DEPORTIVO

A. Requerimientos de fabricación: Todos los componentes deberán ser diseñados y fabricados como un sistema. Todas las luminarias, los arneses de cable, conductores y otros gabinetes serán armados, apuntados, cableados y probados en la fábrica.

B. Durabilidad: Todos los componentes expuestos deberán ser fabricados con materiales resistentes a la corrosión y/o recubiertos para ayudar a evitar la corrosión. Todo el acero al carbono expuesto deberá ser galvanizado en caliente, según la norma ASTM A123. Todo el aluminio expuesto deberá estar tener un recubrimiento de polvo con poliéster de alto rendimiento o estar anodizado. Todos los encastres reflectantes exteriores deberán estar anodizados, recubiertos y protegidos de la exposición ambiental directa para evitar la corrosión o el deterioro de la capa reflectante. Todos los herrajes y sujetadores expuestos deberán ser de acero inoxidable de grado 18-8 o superior, pasivados y recubiertos con resina epóxica termoendurecible con base de aluminio para protegerlos contra la corrosión y el agrietamiento por corrosión y esfuerzos. Los sujetadores estructurales pueden ser de acero al carbono y galvanizado, que cumplan con las normas ASTM A153 e ISO/EN 1461 (para galvanizado en caliente), o ASTM B695 (para galvanizado mecánico). Todo el cableado deberá estar en el interior de las crucetas, el poste o el gabinete de los componentes eléctricos.

C. Descripción del sistema: El sistema de iluminación deberá consistir de lo siguiente:

1. El fabricante proporcionará todos los conductores y equipos eléctricos de apoyo.

    a. Los conductores remotos (drivers) y el equipo eléctrico de apoyo se montarán aproximadamente a 10 pies (3 m) por encima del nivel en gabinetes de aluminio. Los gabinetes deben ser de seguridad táctil e incluyen conductores y fusibles con luces indicadoras en los fusibles para notificar cuando se debe reemplazar un fusible por cada luminaria. La desconexión por circuito para cada estructura de poste se ubicará en el gabinete.

2. El fabricante proporcionará protección contra sobretensiones en el poste o igual o superior a 40 kA por cada línea a tierra (modo común) según lo recomendado por IEEE C62.41.2_2002.

3. Arnés de cable completo, incluyendo manga de protección contra abrasión, pasacables y conexiones con enchufe para instalación rápida y sin problemas.

4. Todas las luminarias, visores y conjuntos de crucetas deberán soportar vientos de 150 mph (67 m/s) y mantener el alineamiento de dirección de la luminaria.

5. Paquete de una mayor protección contra la corrrosión: Debido al entorno potencialmente corrosivo de este proyecto, los fabricantes deben proporcionar documentación de que sus productos satisfacen los siguientes requisitos mejorados, adicionales a la protección estándar de durabilidad especificada anteriormente:

    a) Las superficies horizontales expuestas de acero al carbono en el conjunto de la cruceta deberán estar galvanizadas a un espesor promedio no menor a cinco (5) mil.

    b) Los componentes expuestos de aluminio fundido deberán ser de tipo II anodizado de acuerdo con la norma MIL-STD-8625 y recubiertos con poliéster de alto rendimiento.

    c) Los componentes expuestos de aluminio extruido deberán ser de tipo II anodizado de acuerdo con la norma MIL-STD-8625 y recubiertos con poliéster de alto rendimiento.

D. Seguridad: Todos los componentes del sistema deberán estar listados por UL para la aplicación apropiada.

PARTE 3 - EJECUCIÓN

3.1 TIEMPOS DE ENTREGA

A. Tiempo de entrega de los equipos en sitio: Los equipos deben estar en el sitio 12-14 semanas Max. después de la recepción de la presentación-submittal aprobados y la recepción de la información completa de la orden.

3.2 CONTROL DE CALIDAD EN CAMPO

A. Mediciones de iluminación: Se realizarán y verificarán mediciones de la iluminación cuando el proyecto esté sustancialmente terminado y en presencia del contratista, de la ingeniera del proyecto, del representante del propietario y del representante del fabricante. Las mediciones de iluminación se realizarán de acuerdo con lo establecido en IESNA LM-5-04.

B. Responsabilidad por el nivel de iluminación en el campo

1. Se garantiza que los niveles de iluminación no descenderán por debajo de los niveles de iluminación deseados que deben mantenerse durante todo el período de garantía de 10 años.

3.4 GARANTÍAS

A. Garantía por 10 años: Todos los fabricantes deberán entregar una garantía firmada que cubra el sistema completo durante 10 años a partir de la fecha de embarque. Esta garantizará los niveles de iluminación específicos. El fabricante mantendrá reservas financieras con fondos específicos para garantizar el cumplimiento de la garantía durante su período completo. La garantía no cubre eventos meteorológicos tales como daños por rayos o granizo, instalaciones incorrectas, vandalismo o maltrato, reparaciones o alteraciones no autorizadas, ni productos hechos por otros fabricantes.

PARTE 4 - APROBACIÓN DEL DISEÑO

B. Producto aprobado: El sistema Musco’s SportsCluster System™ con TLC for LED™ es el producto aprobado. Cualquier otro producto tiene que cumplir con las normas establecidas en este pliego, y ser igual o superior.