UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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CORROSION CONTROL HANGAR DOORS

05/17

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SECTION 08 34 16

CORROSION CONTROL HANGAR DOORS
05/17

****
NOTE: This guide specification covers the requirements for fabrication and manufacture of hangar doors used in corrosion control hangars.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

****
NOTE: These doors are unique because they also serve as the air supply plenum.
****

****
NOTE: Painting of hangar doors must be specifically mentioned in Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES, along with a reference to this Section and with instructions not to paint operating parts, mechanisms, limit switches, or trolley ducts.
****

****
NOTE: On the design drawings, show:
1. Size and arrangement of doors. Electrical and structural provisions for motor operators.
2. Location and type of weather stripping, exterior

covering, interior lining and flashing.
3. Location, spacing, size and type of top guides and rails. Center-to-center dimension of leaves including interior and exterior coverings.
4. Location and type of personnel doors. Do not locate personnel doors between wheels and edge of hangar door leaf.
5. Location of bumpers and pulls.
6. That wheels will be required. Type, size, and number should not be shown since size and weight of doors will determine these.
7. Appropriate design wind pressures based on the design wind velocity. See section on "Wind Loads" for more detailed requirements.
8. Details of expansion joints in rails and top guides where building expansion joints occur.
9. Electrical service for motor operators, preferably 460 volts, 3-phase, 60-hertz, and location of power supply disconnect.
10. Access for installation, maintenance, and replacement of top rollers if hangar requires floating top rollers.
11. Dimensions and details of tail doors, if required.
12. Bottom rail drains for full length of bottom rails. This may be done with cross drains normal to the rails spaced about 6 M 20 feet on center. In cold areas it may be necessary to provide de-icing equipment below the rails.
13. End of travel bumpers and bumper supports at end of door travel. Dimension and location should be in accordance with door manufacturer's approved drawings.
****

PART 1 GENERAL

1.1 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.
****

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual
AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN LADDER INSTITUTE (ALI)

ALI A14.3	(2008; R 2018) Ladders - Fixed - Safety Requirements

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

ASHRAE 52.2	(2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A29/A29M	(2020) Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A519/A519M	(2017) Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1008/A1008M	(2020) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM A1011/A1011M	(2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM A1018/A1018M	(2016a) Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B103/B103M	(2019) Standard Specification for Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D740	(2011) Methyl Ethyl Ketone
ASTM D4614	(2011) Standard Specification for Ethyl Acetate (All Grades)
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	(2014) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(2017) Metal Bar Grating Manual

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	(2015) Application Guideline for Terminal Blocks
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 220	(2021) Standard on Types of Building Construction
NFPA 409	(2016; ERTA 2016) Standard on Aircraft Hangars

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-C-22542	(2012; Rev A; Stabilized (S) 2012) Cleaning Compound, High Pressure Cleaner, Liquid
SAE J514	(2012) Hydraulic Tube Fittings
SAE J1405	(2012) Optional Test Procedures for Hydraulic Hose Assemblies

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-D-16791	(1990; Rev G, Am 1 1993; Notice 1 2020) Detergents, General Purpose (Liquid, Non-Ionic)
MIL-DTL-5541	(2006; Rev F) Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-DTL-15021	(2014; Rev B) Hook, Snap Bolt, Swivel-Eye, and Rings
MIL-R-24243	(1994; Rev C, Notice 1 2020) Rivets, Blind, Nonstructural, Retained Mandrel, Open End, Domed Head, Aluminum Alloy, Carbon Steel, Corrosion Resistant Steel
MIL-T-81772	(2019; Rev C) Thinner, Aircraft Coating
UFC 1-200-01	(2019) DoD Building Code
UFC 3-301-01	(2019) Structural Engineering

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-857	(Rev B, Notice 3) Thinner, Dope and Lacquer (Cellulose Nitrate)
FS RR-C-271	(Rev G) Chains and Attachments, Carbon And Alloy Steel

UNDERWRITERS LABORATORIES (UL)

UL 900 (2015) Standard for Air Filter Units

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, 03 30 00 CAST-IN-PLACE CONCRETE, 05 12 00 STRUCTURAL STEEL, 08 11 13 STEEL DOORS AND FRAMES, 08 71 00 DOOR HARDWARE, 43 15 00.00 20 LOW PRESSURE COMPRESSED AIR PIPING (NON-BREATHING AIR TYPE), 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES and 09 90 00 PAINTS AND COATINGS apply to this section with additions and modifications specified herein.

1.3 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Qualifications; G[, [_____]]

Installer's Qualifications; G[, [_____]]

SD-02 Shop Drawings

Door Materials; G[, [_____]]

SD-05 Design Data

Door Structure; G[, [_____]]

SD-10 Operation and Maintenance Data

Lubrication; G[, [_____]]

Air System; G[, [_____]]

Electrical Equipment; G[, [_____]]

1.3.1 Door Materials

Submit design drawings covering door structure, all operating devices, mechanical systems and "U" value

Show all details for construction, installation and operation; size, shapes and thickness of materials, joints and connections; reinforcing; hardware; mechanical devices; electrical devices; and all design and detail data for work of other trades affected by hangar doors.

Submit the door manufacturer's complete schematic compressed air and wiring diagrams, field piping and wiring diagrams, and a complete physical location drawing showing the location of all pressure regulators, gages, metering valves, lubricators, filter-dryers, interlocking valves and controls with the runs of pipe and conduit, pipe size and conduit size, wire number and wire size in each conduit, junction box location and full control mounting details

1.3.2 Door Structure

Submit design calculations covering door structure, all operating devices, mechanical systems and "U" value. A Registered Professional Engineer shall prepare and sign structural calculations.

1.3.2.1 Adjustable Frequency Motor Drive

IEEE 519.

1.3.3 Operation and Maintenance Manuals

Drawings and instructions showing all lubrication points, proper lubricants, lubrication frequency schedule and complete operating instructions. Complete compressed air system schematic and electrical equipment wiring diagrams.

Furnish the above in duplicate to the Contracting Officer.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer's Qualifications

Use a corrosion control hangar door product from a manufacturer who is regularly engaged in the design, fabrication, erection, and service of corrosion control hangar doors of type and size required for this project. The manufacturer shall have at least 5 years of similar corrosion control hangar door design experience. Similar doors must have comparable function and design including size, configuration, type of use, retractable or moving elements, safety features, controls, and other key engineering elements as the door being specified. It is acceptable to show that a series of similar doors collectively meet all comparable elements to the door being specified, although not necessarily individually. Manufacturer must submit written evidence on similar past door designs and installations listing the name, location, contact information of owners, installation dates, overall sizes, features, and other relevant information for experience and qualifications evaluation. Only manufacturers who can submit this evidence of actual installations where the products have proven practical, durable, and require a minimum of maintenance, will be qualified under this specification.

1.4.2 Installer's Qualifications

Installation of the door(s) shall be supervised by a manufacturer's representative and shall be in accordance with approved shop drawings. Installers shall be skilled and experienced in the erection of corrosion control hangar doors of the type specified herein. Installers must submit written evidence of similar past door installations listing the name, locations, contacts information of owners, installation dates, overall sizes, features, and other relevant information for experience and qualifications evaluation.

1.4.3 Warranty

The door manufacturer shall provide a three-year warranty for all mechanical and electrical components against defects in material and workmanship beginning on the date of Project Acceptance.

1.5 DELIVERY AND STORAGE

Deliver materials which are not shop-installed in the doors in original packages, containers, boxes or crates bearing the manufacturer's name, brand and model number. Store all materials and equipment in dry locations with adequate ventilation, free from dust or water, and to permit access for inspection and handling. Handle doors carefully to prevent damage. Remove damaged items that cannot be restored to like-new condition and provide new items.

1.6 DESIGN REQUIREMENTS

1.6.1 Door Design and Components

The corrosion control hangar doors and components indicated in the construction documents are representative of a commercially-available door. Design and fabricate the door to fit within the space allocated and in accordance with the criteria specified herein. Design doors to operate properly without binding, interference, or damage to weather stripping or the adjacent structure. Door must be of limited combustible construction

in accordance with NFPA 220 and NFPA 409.

Submit Calculations sealed by the door manufacturer's registered professional engineer for review.

1.6.1.1 Steel Door Components

Design all supporting, steel bracing and framing steel members in accordance with the specified loads and the requirements of AISC 325 and AISC 360. Design all cold formed steel in accordance with AISI SG03-3. Weld steel in accordance with the AWS D1.1/D1.1M Standards.

1.6.2 Loads

Design the door for the loads in accordance with UFC 1-200-01, UFC 3-301-01 and all other applicable criteria.

1.6.2.1 Wind Loads

****

NOTE: In accordance with UFC 1-200-01 and UFC 3-301-01, the Engineer of Record must show the appropriate design wind pressure for the design of the door on the drawings. The simplified procedure/method must not be used to calculate the design wind pressures for the door, only an analytical procedure is allowed. The building volume accessed by the corrosion control hangar door must be considered "Partially Enclosed". The design pressure must be based on the specific project design criteria and on the design wind velocity for cladding and components with the appropriate tributary area. An example table of required design wind pressures is shown below.

Zone	Effective Area (SF)	Max Positive Pressure (PSF)	Max Negative Pressure (PSF)
?	10	?	?
?	100	?	?
?	200	?	?
?	500	?	?
?	700	?	?

Components and Cladding elements with Effective Areas greater than 65.032 square meters 700 square feet must be permitted to be designed using the provisions for MWFRSs.

****

In the closed position, design doors and all components to withstand the wind pressures indicated by the Engineer of Record. Design all door

components to withstand both the highest positive and negative pressures based on actual tributary area from the wind load indicated.

In addition, design doors and all components to be operational during wind events which cause a positive or negative service load pressure of 0.718 kPa 15 psf on the surface of the door.

1.6.3 Deflections

For any door member, the deflection due to design wind load shall not exceed the member's length divided by 120. Design the differential deflection at the door seals to be less than 51 mm 2 inches.

Design Doors as a system to withstand the upward and downward deflections of the door header structure.

1.6.4 Drive Mechanism

Design the drive mechanism to operate the door against a wind pressure of 5 pounds per square foot perpendicular to the leaf. Design the drive so that when stopped at any point, the door automatically locks in place against a 185 km/h 115 mph wind. Provide sufficient wheel traction to lock hangar doors when the track is wet. Design for the effect door sway and vibration will have on wheel traction in a 185 km/h 115 mph wind.

1.6.5 Door Seals

Use sealing system between door leaf and building, between door leaf and foundation, and between leaf, designed to provide an air tight closure with the building and the ventilation supply air plenum. Coordinate the design of the door seal system with the building architectural and structural details, and the mechanical ventilation systems. Use fully adjustable door seal system to permit initial setting during installation of the doors, and to permit future adjustments. Use door sealing system designed for ease of replacement and that incorporates commercially available components.

1.6.6 Pneumatic Locking Mechanism

Provide manual and pneumatic control devices, piping, tubing and hose for the locking mechanisms. Include the flexible connection to the building air system. Use air system designed to accommodate the non-lubricated building air supply available. Use system designed to maintain air loading of the cylinders at all times except when the lock pins are to be retracted. Locate compressed air accessories, including the filter / regulator assembly, and control valves where they will be readily accessible for maintenance. Secure all tubing runs in the door plenum to the door frame using cushion clamp assemblies spaced to prevent sag in runs. Arrange all tubing runs to prevent accumulated moisture from reaching the air cylinders. Locate air system accessories to be readily accessible for inspection and servicing. Provide manual release of the automatic door in the event of power failure. Accomplish disengagement of the air cylinder by venting the air supply to the cylinder, removing the air loading on the piston. Provide manual retraction of the locking pins by means of a hand pull attachment through a corrosion resistant wire rope cable system.

1.6.7 Electrical Requirements

Use electrical wiring and equipment approved for Class 1, Division 1 locations as described in Article 501 of NFPA 70. Use electric motor (460 V, 3-phase) as prime mover.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Steel

ASTM A36/A36M.

****

Note to the designer:

Include the following paragraphs in Section 05 12 00 STRUCTURAL STEEL.

".1 Top Guides and Bottom Rails for Hangar Doors:

.1.1 Top Guides: Maintain nominal elevation within plus or minus 6 mm 1/4 inch and nominal center-to-center dimension within plus or minus 3 mm 1/8 inch, with variation from nominal no greater than one mm in 2 meters 1/8 inch in 20 feet. Joints of head guides are not required to be welded, but shim and grind so adjoining guide surfaces are not out of line more than 2 mm 1/16 inch. Top guide tolerances shall be met after dead load is imposed on building frame.[Top guide surfaces which will be in contact with rollers during door operation shall be stainless steel framing or structural members.]

.1.2 Hanging Head Flashing: Galvanized steel, not thinner than 1.2 mm thick 18 gage, reinforced as required. Coordinate with hangar door manufacturer. Show exact location and configuration on top guide shop drawings. Top guide and head flashing system shall be shop assembled to verify accuracy of fit and fastener location, and disassembled for shipping. Install head flashing after doors are in place.

.1.3 Bottom Rails: Standard A.S.C.E. or A.R.E.A. weighing not less than [_____] kilograms per meter pounds per yard. Do not install rails until top guide system has been installed. Continuously support rails and anchor as indicated. Set rails to elevation within plus or minus 6 mm 1/4 inch, with variations from elevation no greater rate than one mm in 2 meters 1/8 inch in 20 feet. Nominal design relationship between top guides and bottom rails to be maintained without exception. Center-to-center dimensions of bottom rails to be maintained within plus or minus 3 mm 1/8 inch with variation from nominal no greater than one mm in 2 meters 1/8 inch in 20 feet. Weld rail joints and grind smooth or

provide with splice plate in accordance with ASCE standards."
****

2.1.2 Formed Steel

AISI SG03-3.

2.1.3 Galvanized Steel

Hot dipped galvanized frames in accordance with ASTM A123/A123M.

2.1.4 Sheet Steel

ASTM A1011/A1011M, hot-rolled sheet steel, commercial quality, or ASTM A1008/A1008M, cold-rolled steel sheet, commercial quality.

2.1.5 Galvanized Sheet Steel

ASTM A653/A653M, coating designation G90 galvanized steel sheet, commercial quality.

2.1.6 Exterior Covering

Preform the hanger door/plenums' exterior wall from siding panels over rigid insulation boards, assembled in accordance with the siding manufacturer's standard detail. Provide panels with factory finish equal to Kynar 500 PVDF fluoropolymer

2.1.6.1 Exterior Roof Panels

Coated steel sheets conforming to the requirements of Section 07 41 13 METAL ROOF PANELS, with ribbed exterior face, 38 mm 1-1/2 inch panel, depth and thickness to meet design loads and purlin spacing, but not less than 22 MFG STD gage, with factory finish equal to Kynar 500 PVDF fluoropolymer.

2.1.6.2 Liner Panels

Coated steel sheets conforming to the requirements of Section 07 41 13 METAL ROOF PANELS, or galvanized steel sheets conforming to ASTM A653/A653M, coating designation G90, with flush interior face, 47.6 mm 1-7/8 inch panel depth and thickness to meet design loads and purlin spacing, but not less than 22 MFG STD gage, with factory finish.

2.1.6.3 Insulation

Permanently secure insulation materials in place between the face and line panels. Design the doors to have an air-to-air "U" value not more than 0.05, a flame spread rating of 75 or less and a smoke-developed rating of 100 or less when tested in accordance with ASTM E84. Do not use cellular plastics.

2.1.6.4 Accessories

Sheet metal flashings, trim molding, closure strips, caps, subgirts and other similar sheet metal accessories used in conjunction with the preformed panels shall be of the same material and finish as the panels. Metal shall be of a thickness not less than that used for the panels.

2.1.7 Hardware

Provide hardware suitable for use on hangar doors and designed to accommodate actual dead loads plus wind loads specified herein.

2.1.7.1 Pivots

Provide pivots with heavy duty thrust bearings sealed against dust and water, and with drip-type lubrication fittings requiring infrequent attention. They shall be of sufficient strength to resist all loads specified herein, with a factor of safety of 2. Provide for expansion and contraction over a temperature range of 27 degrees C 80 degrees F. Design the top pivot to provide movement in the plane of the door to accommodate a differential settlement of 101.6 mm 4 inches within the length of the track and between the track and the building. Design the top pivot to provide movement in the plane of the door in the closed position to accommodate a horizontal displacement of the building of vertical door alignment adjustments at the top and bottom pivot points. The bottom pivot point shall be self-aligning and installed in a cement case with removable weather tight cover, and shall be designed to resist axial and radial thrust loads.

2.1.8 Weatherstripping

Rubber bulb seals shall be resistant to incidental contact with the following chemicals and solvents used in the facility:

MATERIAL	MILITARY OR FEDERAL SPECIFICATION
MEK	ASTM D740
Dope and Lacquer Thinner	CID A-A-857
Aircraft Coating Thinner	MIL-T-81772
High Pressure Cleaning Compound	SAE AMS-C-22542
Ethyl Acetate	ASTM D4614
Non-Ionic Detergent	MIL-D-16791
Conversion Coating	MIL-DTL-5541

2.1.9 Fasteners

Hot dipped galvanized.

2.1.10 Sealant

Single-component or multi-component elastomeric type conforming to ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Provide a sealant that has been tested on the type(s) of substrate to which it will be applied.

2.1.11 Light Fixtures

The door manufacturer shall provide all light fixtures indicated in or on the door. Conform to the electrical drawings and the requirements specified in 26 20 00 INTERIOR WIRING SYSTEMS.

2.1.12 Personnel Emergency Pass Doors and Plenum Access Doors

Provide doors in each hangar door leaf for personnel access to the building, and for access to the air plenum for maintenance of the drive mechanism and lock pin mechanisms. Doors shall be exterior, hollow metal, flush type, insulated, with gasketed frame to provide an airtight seal. Doors shall conform to 08 11 13 STEEL DOORS AND FRAMES. Provide hardware conforming to 08 71 00 FINISH HARDWARE, as follows:

a. Personnel Pass Doors:

1-1/2 Pairs, Hinges	A5111 (Temp.) 5 by 4-1/2
1 Each Exit	Type 2, Function 01
1 Each Door Closer	C02061, Size IV
1 Each Kickplate	J102
1 Set Airtight Seals	As specified

b. Personnel Pass Doors:

1 Pair, Hinges	A5111 (Temp.) 5 by 4-1/2
1 Each Lockset	Series 1000, Grade 1, Function F04
1 Each Door Closer	C02011, Size 111
1 Set Airtight Seals	As specified

2.1.13 Concrete and Non-Shrink Grout

Pour in place normal concrete having a strength of 3000 psi. Concrete and non-shrink grout shall conform to the requirements of 03 30 00 CAST-IN-PLACE CONCRETE.

2.1.14 Filter Assembly

The filter system for the hangar doors shall consist of a replaceable media filter system in a permanent frame filter bank mounted in the door frame as indicated. The filter frame bank shall consist of universal modular frames, nominal 0.6 m by 0.6 m 24 inch by 24 inch, fastened to each other to form an assembly. Fabricate frames from 16 gage galvanized steel and include filter holding clips to permit easy removal of the filters without removal of the clips. Fasten frames to each other and to the supporting door frame by means of stainless steel break mandrel rivets (pop rivets) conforming to MIL-R-24243. Use replaceable filters of the extended surface type, nominal 0.6m by 0.6 m by 51mm 24 inch by 24 inch by 2 inch deep, with a 30 percent efficiency when rated by ASHRAE 52.2.

Filters shall meet the fire-resistant requirements of UL 900, Class 1. Use pleated type filters with a welded wire media support grid and nonflammable enclosing frame bonded to the filter media. Provide one complete set of replacement filters for each door leaf.

2.1.15 Differential Pressure Switches

Provide each door leaf with a differential pressure switch to annunciate when the filters are dirty and require replacement. Provide 101.6 mm 4 inch diaphragm operated differential pressure switches to activate a single pole double throw snap switch. Restrain motion of the diaphragm by a calibrated stainless steel spring adjustable through the full range. Transmit spring range the snap switch by means of a direct mechanical linkage. Switch shall be rated for a temperature range of minus minus 1 degree C 30 degrees F to 82.2 degrees C 180 degrees F, and a pressure of 10 psig. The operating range shall be 1/2 to 2 inch water column with a maximum dead bank of 0.12 inches water column, and repetitive accuracy of 2 percent of range. Use U.L. listed switch mounted in an explosion-proof housing suitable for use in a Class 1, Division 1, Group D hazardous area. Use 3.2 mm 1/8 inch NPT pressure sensing connection. Use 12.7 mm 1/2 inch NPT electrical connection. Use switch rated 15 amps, 120 volt A.C., resistive load.

2.1.16 Door Drive Mechanism

Each door leaf shall be driven by a single drive wheel operating on an embedded standard crane rail. The drive wheel shall be driven by an electric worm gear motor through a double reduction chain and sprocket. The drive mechanism shall be capable of operating the door under the design loads specified herein.[For areas classified as Class 1, Division 1, Group D hazardous areas, all moving parts exposed within the door plenum and the aircraft by shall be non-sparking, except where protected by drive system sealed enclosure. Limit the acceleration of the door to reduce the potential hazard of the drive wheel sparking the rail.] Incorporate machinery in the drive mechanism to permit the door leaf to be operated manually by means of a tractor in the event of a power failure or motor drive failure. The drive mechanism shall be of the design indicated, or shall be of a comparable, previously-proven design for a similar type door which shall be approved by the CQC Representative.

2.1.16.1 Worm Gear Motor

The gear motor shall consist of a multiple reduction helical worm gear reducer with an integrally mated A.C. motor and electric brake.

2.1.16.2 Gear Reducer

The gear reducer shall be A.G.M.A. rated for the design torque with a service factor of 1.0. Use gear reducer housing of high strength cast aluminum or cast steel. The worm shall be machined of high strength leaded alloy steel carburized and hardened to 60-62 Rockwell C, tempered, honed and ground after hardening. The worm gear shall be cast bronze. The output shaft shall be high strength alloy steel. Bearings shall be either tapered or ball rollers on the work shaft and tapered rollers on the output shaft. Use dual lip spring-loaded seals to protect against leakage and foreign matter. Use gear reducer with a large oil reservoir for adequate splash lubrication for cool operation and an easily accessible oil fill, level and drain holes for maintaining proper oil level. The gear reducer shall have an adaptable base, machined for direct

mounting to the support structure.

2.1.16.3 Motor

****
NOTE: Provide a Totally Enclosed Wash-Down (TEWD) motor enclosure in harsh salt air marine environments. Hangar doors have a history of early motor failure where facilities are adjacent to the ocean.
****

Use integrally mated motor suitable for variable speed operation with input power from an adjustable frequency drive unit,[explosion-proof for areas designated as Class 1, Division 1, Group D hazardous areas,][totally-enclosed, wash-down (TEWD)] constant torque, NEMA Design D, 3 phase, 60 hertz, 460 volt service, with Class B insulation, time and temperature rating 30 minutes 75 degrees C 167 degrees F temperature rise over 40 degrees C 104 degrees F ambient, 1.2 service factor and with sealed bearings. Include in motor an integrally mounted disc brake in an explosion-proof enclosure. Brake shall have a manual release with automatic reset. Extend shaft through brake for manual operation. Select motor for starting torque and not stall torque. Motor shall conform to NEMA MG 1 standard.

2.1.16.4 Chain and Sprocket Drive

Accomplish double reduction chain and sprocket drive through a sprocket mounted on the output shaft of the gear motor, a sprocket mounted on the drive wheel shaft and an intermediate jack shaft with sprockets. Use single or double strand type sprockets to match the ANSI pitch chain with hardened steel teeth. Use sprockets designed to have a minimum of 40 percent tooth contact. Use jack shaft designed with a clutch mechanism to permit disengaging the gear motor drive from the drive wheel to permit manual operation of the door. Use jackshaft fabricated from high strength alloy steel and supported by two pillow blocks or flanged bearings. Use bearings designed for an L10 life of 20,000 hours, with self-aligning double row spherical bearings in a cast iron housing, a spring locking collar, spring loaded lip seals and grease fittings. Use manual clutch mechanism with a handle of sufficient length to facilitate manual operation and a latching device to assure positive engagement under normal operation when not mechanically retracted for manual operation. Fit the chain and sprocket drive system with an automatic oil lubricator readily accessible for inspection. Use roller chain of single or double strand conforming to ANSI standards for dimensions. Use roller chain of heavy series type rated for occasional shock loading. Use press fit riveted type pins. Use press fit cotter pin type connecting pin.

2.1.16.5 Drive Wheel Truck Assembly

Mount each drive wheel on a removable truck assembly, as indicated, to permit removal and servicing without dismantling the door.

2.1.16.6 Drive Wheel

Use wheel fabricated from heat treated chromium-molybdenum alloy, AISI strength. Use wheels designed to operate on a standard crane rail as specified herein. Use wheels conforming to the following dimensions after machining:

a. Diameter of tread	533.4mm to 0.13 mm21.0 inch to 0.005 inch
b. Width of tread	82.6 mm3 1/4 inch
c. Bore	As required

After machining, flame harden wheels to 325 to 375 brinell hardness.

2.1.16.7 Shafting

Fit and weld wheels to a high strength steel tube shaft. Machine tube shaft from hot finished seamless carbon steel mechanical round tubing conforming to ASTM A519/A519M, and steel conforming to ASTM A1018/A1018M with a wall thickness as required by design. Machine tubing shaft to receive bearings so that the combination with the wheel shall be concentric with the bearings and support shaft within a tolerance of 0.5mm 0.002 inches. Run tube shaft on tapered roller bearings press fit into the ends of the tube. Ends of tube are supported by a high strength machined inner shaft mounted directly to the wheel truck. Machine inner shaft from medium carbon, high manganese, free machining, cold finished, Stress proof steel shafting, drawn, ground and polished with a tensile strength of 125,000 psi and a yield strength of 100,000 psi. Drill and tap inner shaft to accommodate lubrication tubing and to permit distribution of grease to both bearings.

2.1.16.8 Tapered Roller Bearings

Use self-aligning, cylindrical bore, spherical roller type bearings, sized for the static and dynamic forces with an LB-10 minimum life rating of 20,000 hours. Use manufacturer's standard precision machined self-locking bearing nut for retaining the bearings on the shaft. Machine bearing sleeve for preloading the tapered roller bearings from Stress proof steel shafting used to support the wheels.

2.1.16.9 Fabricated Truck

Use plate conforming to ASTM A36/A36M except as indicated and specified herein.

2.1.16.10 Seals and Seal Housing

Fabricate seal housing as indicated for clearance fit to shaft and sleeve. Use double lip, spring loaded seal to retain bearing lubricating grease and protect the bearings from dirt.

2.1.16.11 Bearing Lubrication Components

Use copper tubing the size indicated conforming to ASTM B88, Type L, for use with compression type fittings. Use brass fittings conforming to SAE J514 to connect tubing to shaft and to truck. Use male connector fitting for connection to shaft, male pipe end and flare tube end to receive tubing. Use "Triple-Lok" fittings as manufactured by Parker Hannafin, or approved equal. Provide alemite grease fitting to mate with bulkhead female pipe fitting.

2.1.16.12 Door Drive Mechanism Enclosure

Design and fabricate drive mechanism enclosure to be readily removable to facilitate inspection and maintenance of the mechanical drive components. Fabricate enclosure to airtight to maintain the integrity of the pressurized air plenum.

2.1.17 Lock Pins

Equip leading edge of doors with top and bottom automatic lock pins designed to restrain the door in the full open or full closed positions, under the design operating wind forces. Assure that doors are properly aligned in the fully closed position with seals compressed. Use non-sparking lock pin mechanisms designed to accommodate thermal expansion and contraction of the doors, with sufficient range of action horizontally to seat under full wind load deflections (inward or outward). Seat bottom lock pins in special receptacles set in the concrete slab designed to accommodate the full travel of the pin, and designed to prevent dirt and water from accumulating inside. Use air operated lock pins designed for normal operating conditions with mechanism to manually release the pins in the event of a failure of the control system. Use lock pin mechanism of the design indicated, or of a comparable, previously proven design for a similar type door approved by the CQC Representative.

2.1.17.1 Operating Mechanism

Use direct action double acting air cylinder operating mechanism for opening and closing the lock pins. Use cylinders sized to operate the lock pins when binding in the receivers under full wind loads or other combination of loads including thermal expansion and contraction of the doors, and settlement deflection of the doors with available 80 psig air. Use cylinder of corrosion-resistant construction suitable for industrial application and rated for 200 psig non-lubricated air service. Machine cylinder barrel head from high strength steel tubing, honed to a 10-15 micron-inch finish and hard chrome plated inside and outside. Fit head with easily externally removable precision machined high strength fine grained iron, bronze or aluminum rod bearing, incorporating seals and rod wiper to prevent dirt form entering cylinder. Use cylinders cushioned at both ends with built-in adjustable needle valves to allow adjustment of the cushion effect. Fit piston with double seals for minimum friction under varying dynamic pressures. Machine cylinder rod from high strength steel, 90,000 to 100,000 psi minimum yield, hard chrome plated, and sized for operating the pin with a factory safety of five based on yield strength. Pre-lubricate cylinder with a permanent type dry lubricant. LR2 Permanently Lubricated Air Cylinders or Universal "A-2" Series Heavy Duty Pre-Lubricated Pneumatic Cylinders as manufactured by Schrader Bellows of Akron, Ohio conform to this specification.

2.1.17.2 Top Pin

Machine top pin cold drawn ASTM A29/A29M, Grade 1018 steel bar stock. Hard chrome plate top pin after machining. Machine pin bottom to mate with the clevis fitting on the air cylinder. Use two sets of bronze guide rollers to guide pin for the full stroke. Use bronze rollers designed to accommodate the maximum forces under the design loadings plus: forces due to temperature expansion and contraction of the door,; forces due to settlement of the door; and other binding forces on the top pin when engaged in its receiver. Use top pin latching receiver assembly designed to accommodate the maximum pin loading and to mate with the 12.7 mm 1/2

inchbuilding truss plate provided for the lock mechanism. Use receiver assembly provided with a phosphor bronze liner sheet conforming to ASTM B103/B103M with a hard temper, minimum tensile strength of 80,000 psi and Rockwell Hardness Number B86.

2.1.17.3 Bottom Pin

Machine bottom pin from cold drawn ASTM A29/A29M, Grade 1018 steel cold finished round stock. Machine pin to thread to the cylinder rod. Guide pins at the bottom of door with UHMW supported in a fabricated steel bracket. Engage pin in sockets embedded on the floor. Use sockets with UHMW sleeves.

2.1.17.4 Air System

Use air system for operating the lock pins consisting of shop compressed air available near each door at 12.7 mm 1/2 inch valved connection on the aircraft by wall as indicated. The compressed air is classified as industrial plant grade air at a pressure of 100 to 125 psig. The door manufacturer shall provide appropriate air accessories such as valves, regulators, filters, dryers and gages for the operating and control equipment, to ensure trouble-free service.

a. Air Filter: Each door leaf control air system shall be served by a primary filter separator provided immediately ahead of the pressure regulator. Use filter separator sized for the maximum air flow. Use filter separator capable of separating free water from other liquids, and particulates larger than 5 microns that may cause damage to the pneumatic equipment. Use filter separator with a transparent bowl guard, non-corrosive filter element. Include an automatic drain and replaceable filter elements for filter separator. Provide two spare filter elements for each filter.

b. Pressure Regulator: Serve each door leaf control air system by a pressure regulator to reduce the 100 to 125 psig plant supply air to 90 psig to provide the regulate air supply for the cylinders. Use relieving regulators with T-bar stem locking handle. Include a pressure gage with a range of 5 to 125 psig.

c. Air Exhaust Mufflers: Pipe venting and exhaust of control air systems through a muffler to reduce noise level. Use expansion chamber muffler with a built-in resonator and air disseminator. Use muffler constructed entirely of corrosion-resistant metal.

d. Directional Control Valves: Control operated cylinders by means of a solenoid pilot operated directional control valve suitable for operation in a hazardous location classified as Class 1, Division 1, Group D, approved for rain tightness. Use 2-position, 4-way, single solenoid, pilot actuated, spring return type for solenoid control valve. Use valves rated by manufacturer as suitable for the non-lubricated air service provided. Use internally supplied pilot. Use continuous duty rated solenoid suitable for 115-120 volt A.C. service with Class "A" (105 degrees C221 degrees F) insulation.

e. Piping System: Use Type K, fully annealed seamless copper tube conforming to ASTM B88 for lock pin pneumatic control piping, including field piping and prefabricated shop assembled components. All fittings employed in the piping system, conforming to SAE J514, except the fitting material shall be brass and bronze compatible with

the copper tubing. All factory assembled components shall employ cushion type tubing supports for supporting the tubing runs. Use SAE J1405 air hose rated for 250 psig for flexible hose connection between the building supply and the door. Use hose constructed of a synthetic rubber inner tube, a single partial stainless steel wire braid reinforcement covered by a protective synthetic rubber layer and an outer synthetic rubber impregnated textile cover. Fit hose with brass swivel type reusable fittings.

2.1.18 Top Lock Pin Maintenance Platform

Provide a platform, as required, for maintenance of the top lock pin mechanism.

2.1.18.1 Metal Grating

Platform metal grating shall conform to NAAMM MBG 531.

2.1.18.2 Handrails

Fabricate handrails from standard-weight steel pipe, nominal inside diameter 38.1 mm 1-1/2 inches. Use hot-dipped zinc-coated finished railing assemblies conforming to ASTM A123/A123M. Complete railing with standards, brackets, caps, plugs, toe guards and all other accessories and fastenings for complete job. Fabricate railings in one length for each run and securely anchor to the supporting structure. Conform railing to the requirements of Occupational Safety Health Act Article 1926.500.

2.1.18.3 Jointing

Perform jointing of posts, rail and corners by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints and grinding smooth. Butt railing slices and reinforce with tight fitting interior sleeve not less than 152.4 mm 6 inches in length. Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and that the pipe is not crushed. Weld posts welded directly to the steel platform structure.

2.1.18.4 Ladders

Fabricate vertical ladders conforming to ALI A14.3 of 63.5 mm by 9.5 mm 2-1/2 inches by 3/8 inches steel flats for strings and 19 mm 3/4 inch diameter steel rods for rungs. Space rungs a maximum one foot apart, and plug weld or shoulder and head into strings. Hot dip galvanized ladder assemblies after fabrication in conformance to ASTM A123/A123M. Install ladder so that rungs are not less than 177.8 mm 7 inches from the finished wall surface or other structural element. Secure ladder to adjacent construction with heavy clip angles welded to the string and secured to structure as indicated. Install intermediate clip angles not over 1.2 m 48 inches on centers. Install brackets as required for securing to ladders. Provide safety cage and spreaders as required.

2.1.18.5 Safety Chains

Construct safety chains of 3/16 inch, zinc-coated, steel welded chain conforming to FS RR-C-271, Type 1, Group C, Class 4 with snap bolt hook with ring on both ends and eye bolt on both ends. Use swivel eye snap bolt hooks conforming to MIL-DTL-15021. Use galvanized eye bolts with 9.5 mm 3/8 inch bolt and 19 mm 3/4 inch eye diameter for attachment of

chains. Supply two chains, 101.6 mm 4 inches longer than the anchorage spacing, for each guarded area. Mount top chain 09 m by 1.8 m 3 feet to 6 feet above the platform floor. Mount lower chain 0.6 m to zero m 2 feet to zero inches above the platform floor.

2.1.18.6 Structural Framing

Provide additional structural framing welded to the tubular structure to accommodate the platform load.

2.1.19 Electrical Equipment

Provide electric motors, wire and equipment specified under this section conforming to 26 20 00 INTERIOR DISTRIBUTION SYSTEM, NFPA 70 and NEMA ICS 1, NEMA ICS 2 and NEMA ICS 6. All electrical wiring entrances and equipment within the door and mounted on the door within the aircraft bay shall be constructed to NEMA ICS 6 standards [NEMA 250 Type 4/7 for hazardous locations]. Use watertight, NEMA ICS 6, Type 4 enclosures for all electrical wiring and equipment on the exterior of the door.

2.1.19.1 Plenum Lights

Provide fluorescent or LED lights within the door plenum to provide lighting for servicing the drive mechanism and the lock pin mechanisms. Light levels at each maintenance spaces shall be 5 footcandles. Use a switch mounted in the personnel access vestibule adjacent to the plenum access door for light control. Use[combination explosion-proof and] weatherproof switch for plenum lights. Use 120 volts A.C. obtained from the door drive control transformer as indicated for circuit lighting.

2.1.19.2 Controls

Use two joysticks as part of the controls for each door. Require that operator maintain constant contact with joystick for door drive motor to be engaged or energized. Locate a pushbutton on each side of the door at the "seeing" end with control configuration such that either of the two joysticks can maintain door movement. Locate joysticks such that the operator can "walk" the door to either the open or closed position and have view of the direction of travel while maintaining the hand activation of the joystick. Design door to automatically stop if the operator's hand is removed from the joystick. Include an audible and visual alarm to be activated when the door is in motion. Alarms shall have a distinct warning sound and visual display that is different than all other warning systems in the hangar bay.

Include proximity sensors[and][or]switches to detect "near end of travel" and "end of travel" in door and door apron. Include adjustable acceleration and deceleration ramping from zero to maximum speed and from maximum to zero speed in door motor drive. Include an automatic "soft start" with gradual acceleration to a pre-set maximum speed. Include capability to adjust maximum speed. Include automatic deceleration and a gradual stop when a "near end of travel" point is reached. Include automatic disengagement or de-energization when door "end of travel" is reached. Include capability of door motor drive reversing, such that the door can be powered open and powered close.

2.1.19.3 Control Cabinet

House all applicable control components for the door in each control

cabinet. Use factory installed and wired control cabinet components for each door. Locate control cabinet on the exterior face of door and size for the electrical control equipment indicated and specified herein. Surface mount cabinet: NEMA ICS 6 Type 4 classification. Fabricate cabinet of 14 gauge steel minimum with all seams continuously welded. Use a 12-gage back panel, for mounting equipment and devices, mounted on collar studs welded to the back face of the enclosure. Use heavy duty continuous hinged door constructed with rolled edge. Attach a neoprene gasket to doors with oil resistant adhesive and steel retaining strips. Provide stainless steel door clamps to hold the door securely closed. Punch holes in door to accept control switches and indicator lights as indicated. Include an exterior flange mounted NEMA ICS 6 Type 4 disconnect switch. Interlock the padlockable operating switch handle with the cabinet door so that the door can only be opened when the disconnect switch is open. Size the switch based on the voltage and electrical load in accordance with NFPA 70. Cabinets shall contain the following equipment.

a. A microprocessor-based adjustable frequency motor drive unit (for each door) such that the door drive motor (460 volt, 3 phase) shall have variable speed capability. Make drive until capable of reversing. Motor protection in compliance with NFPA 70, Article 430. Make drive until capable of producing a controlled adjustable frequency/voltage output at suitable power levels to successfully operate the door drive mechanism.

   Use UL listed adjustable frequency drive unit in compliance with IEEE 519. Use additional supplemental equipment as necessary to comply with IEEE 519. Submit a mathematical analysis by the drive until vendor verifying compliance.

   The adjustable frequency drive units shall have as a minimum the following features:

   (1) Ambient operating temperature range:
       (a) 0 to 40 degrees C 32 to 104 degrees F.
       (b) Humidity 5-95", non-condensing.

   (2) Electrical:
       (a) Input Voltage: 460 VAC < plus 10 percent, minus 5 percent. 3-phase.
       (b)Input Frequency: 58-62 Hz.
       (c) Output Voltage: 0-460 VAC, 3-phase.
       (d) Output Frequency: 3 -60 Hz. The output shall be as a result of a sine coded pulse width modulated (PEM) output from the inverter section. Frequency regulation shall be plus 0.5 percent of maximum.
       (e) Current ratings: continuous for 100 percent of drive rating, 120 percent for one minute.
       (f) Electronic circuitry protection.
       (g) Minimum .94 power factor.

   (3) Programmable functions:
       (a) Acceleration rate.
       (b) Deceleration rate.
       (c) Voltage boost.
       (d) Maximum frequency.
       (e) Output current limit.
       (f) Motor overload.

(g) Reduced volts per Hertz.

(4) LED or digital display of the following:
(a) Overvoltage.
(b) Undervoltage.
(c) Ground fault..
(d) Instantaneous current
(e) Overtemperature.

b. Use control transformers rated 2 KVA 480-120 volts, 60 Hz.

c. Use door mounted indicator lights, NEMA ICS 6, Type 4 transformer style, push-to-test type for operation up to 120 volts AC/DC. Use colored lens as indicated. Square D Type SK control units conform to this specification.

d. Door mount push-button switches, NEMA ICS 6, Type 4, 4X momentary contact type for operation on 120 volts AC. Use black buttons, except use red for "off" and "open" buttons. Include extended guards for pushbuttons to protect against accidental operation.

e. Use control relays rated at not less than 250 V, 60 Hz, 10 A contacts, 120 V, 60 Hz coils. Use plug in type, suitable for mounting to the back panel of the control cabinet with clamp type terminals. Furnish a minimum of one spare contact per relay. Use break coil relays rated for 600 V.

f. Use programmable logic controller (PLC) to perform all control and timing of door operation. I/O no greater than 1200 AC or DC. Use relay suitable for mounting to the back panel.

[g. Use Factory Mutual approved intrinsically safe barrier relays for hazard classification Class 1, Division 1, Group D. Suitable for use with a "close" pushbutton. Capable of switching a 120 V, 60 Hz, 5A load and withstanding 20 A inrush in one second. Use encapsulated, irreparable, and vibration resistant relay.

] h. Use solid-state pulsating type piezoelectric horns suitable for use at 120 V, 60 Hz. Produce a one-half second intermittent 3900 Hz tone of approximately 50 percent duty cycle. Minimum sound level 85 dB at 0.6 m 2 feet on axis. Suitable for door mounting with screw type terminals.

i. Use barrier type terminal blocks made of thermosetting phenolic or nylon rated for 600 V, 20A with a maximum operating temperature of 121 degrees C 250 degrees F. Use tabular screw blocks with pressure plate terminals. Locate marking strips on the top of the terminal block and center between the binding screws to permit full access to the binding screws with the marking strip in place.

j. Use 120 V fuses, 31.8 mm 1-1/4 inch, quick blow cartridge type in suitable fuse block for back panel mounting. Capable of handling 20 A continuous with screw or clamp type terminals.

k. Fabricate nameplates from plastic laminate 3-ply engraving stock, minimum thickness 0.79 mm 1/32 inch, dark blue with white core. Characters a minimum of 3.12 mm 1/8 inch high, all capitals, gothic, unless noted otherwise. Engrave information; locate as indicated. Unless noted otherwise, determine nameplate length and height to fit

legend and to present a neat and pleasing appearance. Engrave legend plates at pushbuttons and indicator lights engraved as indicated.

l. Provide cooling fans if necessary for proper cooling of cabinet components.

2.1.19.4 Joysticks

On the control cabinet door and the interior face of the door, use bidirectional spring-return-to-center type joysticks with normally open contacts as indicated. Handle 95.3 mm 3-3/4 inches long, threaded to accept a spherical phenolic knob. Comply with NEMA ICS 4, suitable for 120 volts 60 hertz operation. Install joystick on the interior face of the door in a NEMA ICS 6 Type 4 enclosure. As of publication, Cutler Hammer File E20 two position joysticks conform to this specification.

2.1.19.5 Limit Switches

Use heavy duty type limit switches, mechanically actuated,[in a NEMA ICS 6 Type 4, 7 explosion proof weathertight enclosure][in a NEMA ICS 6 Type 4 weathertight enclosure]. Use contacts rated 10 amperes, 600 volts, DPDT. Use limit operable in ambient temperatures from minus 23.3 to 85 degrees C minus 10 to 185 degrees F. Microswitch Type LCS and HDLS limit switches conform to this specification.

2.1.19.6 Klaxon Horns

Use weatherproof, A.C. vibration type horns for annunciation of door movement suitable for operation on 120 volts 60 hertz. Use horns with adjustable volume, range of 78 to 128 db SPL measured on axis at 3.04 m 10 feet.

2.1.19.7 Explosion Proof Control Devices

On the door interior face use weathertight and explosion proof indicator lights and pushbutton (Class 1, Division 1, Group D, hazardous area), suitable for use in 120 volt 60 hertz control circuit. Use NEMA ICS 6, Type 4, 7 enclosures as indicated.

2.1.19.8 Interconnecting Cable

Between each door and building interface junction box, use cable Type SO, UL listed, neoprene jacketed, 600 volt rated, of the number of conduits and gage indicated. Use cable consisting of multiple stranded bare copper conductors, with a flexible heavy duty black neoprene jacket overall suitable for exterior installation to resist ozone, sunlight, moisture, oil and abrasion. Supply cable of sufficient length to accommodate the door swing.

2.1.19.9 Conduit, Wire and Fittings

a. Conduit: rigid hot dipped galvanized steel with thread connections.

b. Within the control cabinet, use stranded copper wire type SIS. Minimum size power wiring: No.12 AWG. Minimum size control wiring: No.14 AWG. In conduit, use stranded copper wire Type THWN No.14 for control and No.12 for Power.

[c. Within the door and on the interior wall use explosion proof and

weathertight boxes and fittings, NEMA ICS 6 Type 4, 7.

d. Use conduit seals suitable for Class 1, Division 1, Group D hazardous area.

] e. Use watertight fittings for Type SO cable.

[f. In hazardous areas use flexible conduit suitable for installation in a Class 1, Division 1, Group D hazardous area.

]2.1.19.10 Rotating Beacons

Use rotating beacons rated 60 hertz 120 volts or 360 degree rotation, weatherproof, red dome, gasketed aluminum shock mount housing, suitable for 25.4 mm 1 inch stanchion mounting.

2.2 FABRICATION

2.2.1 Doors

Use door leaves fabricated from hot rolled sections or structural tubing in accordance with AISC 325 and AWS D1.1/D1.1M. Welded joints except where impractical. All joints shall develop 100 percent of the strength of the framing members.[Prepare splices accurately to facilitate field assembly in accordance with standard practice.] Use frames and framing members true to dimensions and square in all directions; no leaf shall be bowed, warped or out of line in the vertical or horizontal plane of the door opening by more than 3.2 mm in 6.1 m 1/8 inch in 20 feet. Provide bracing so that the completed leaf assembly will be adequately braced to withstand shipping, assembly and operational loads. Ground smooth exposed welds and welds which interfere with the installation of parts such as wall panels and cove sheets. Seal flat cover sheets with sealant and fasten to frame either by edge welding, plug welding or threaded fasteners on 304.8 mm 12 inch centers. Prepare, prime, and coat structural framing and miscellaneous steel as specified in paragraph FINISHES. Seal joints in assembled door/plenum to provide an airtight plenum.

2.2.2 Latches

Provide automatic latching devices at top and bottom of doors to take over positioning of the doors during closing, compress the seals, and anchor the door against full wind and seismic loads. Use devices with sufficient throw to allow for thermal expansion and contraction of the doors, and sufficient range of action horizontally to set under full wind deflection, inward or outward. Provide an automatic foot bolt to anchor the door in fully open position. seat bottom bolts in dust-proof strikes set in concrete pavement. Interlock latching devices with motors to prevent door operation unless the bolts are fully retracted.

2.2.3 Tractor Pulls

Provide tractor pulls so that leaves can be towed by a tractor or similar equipment. The tractor pull shall be designed for a drive force to tow door of 22240 N 5000 pounds whichever is greater. Minimum thickness steel plate shall 10 mm 3/8 inch.

2.2.4 Exterior Covering

Install exterior covering on the assembled door structure in accordance

with the siding manufacturer's recommendation and approved shop drawings. Form and seal joints so that both sides of the covering are weathertight and the plenum is airtight.

2.2.5 Interior Covering

Fabricate interior wall of hangar door/plenums of aluminum sheet, perforated in a regular pattern with holes 12.7 mm 1/2 inch diameter providing the total free area per door leaf indicated. Use sheet sufficiently thick to meet design loads and purlin spacing. Install sheets with the smooth side of punched holes on the exterior face of the door. Fasten sheets in place to vertical and horizontal framing members at 304.8 mm 12 inches on center maximum with No. 14 or larger, self-tapping screws. Seal joints to provide an airtight plenum.

2.2.6 Weatherstripping

Install resilient bulb seals as[shown][required], to provide a weathertight seal around the perimeter of the door leaves and an airtight seal at the perimeter of the plenum opening mating surfaces with the supply ducts at the door head. Provide seals with molded or vulcanized corners. Reinforce bottom seals with woven fabric. Install seals designed to allow for horizontal displacement of the building at the head of the door plus or minus 76.2 mm 3 inches in the plane of the door in the closed position under seismic loading.

2.2.7 Support Rail

Use support rail as indicated per civil drawings to support wheel loads. Furnish complete with anchor bolts and leveling plates as indicated, installed by the door manufacturer. Set the rails to the indicated radius, plus or minus 3.2 mm 1/8 inch and leveled to within plus or minus 2.5 mm to 3.0 m 0.1 inch to 10 feet. From side to side, the top of the rail shall not vary more than 2 degrees from true level.

2.2.8 Services

The door manufacturer shall provide all piping, wiring and devices in the door.

2.2.9 Perforated Aluminum

Attach the aluminum perforated sheets to the door frame with plated fasteners with neoprene washers at not more than 304.8 mm 12 inches on centers. Protect dissimilar metals with bituminous paint. The thickness of the sheet .10 5052 alloy H32 hardness. Holes shall be [_____] mm inch at 25.4 mm 1 inch on centers. 8 percent open.

2.2.10 Electrical

All manual and automatic control devices, control cabinets, light fixtures, door mounted interface junction boxes with cable and all conduit and wiring mounted on the doors and specified herein shall be provided under this section. Raceways and interconnect wiring within the aircraft bays will be provided under 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Use color coded wiring, clearly labeled with identification numbers in accordance with approved shop drawings. Make individual wire identification at all terminations with wire numbers stamped on durable plastic heat-shrinkable sleeving, 19.1 mm 3/4 inch minimum length. Neatly

train and lace wiring within the cabinet or run in plastic wiring ducts. Make cable connections to boxes watertight cable clamps. Make conduit connections to motor and limit switches with flexible conduit[explosion proof in Class 1, Division 1, Group D hazardous areas] or liquid tight flexible conduit to permit servicing of equipment and of sufficient length to permit field adjustment. Secure conduit to the door structure.[Provide conduits entering hazardous areas and areas with arcing devices with conduit seals in accordance with NFPA 70.] Install conduit runs to permit easy access to junction boxes and not to interfere with the operation of the door or with servicing of components. Electrical installation shall conform to the requirements of 26 20 00 INTERIOR WIRING SYSTEMS, and NEMA ICS 1.

2.3 FINISHES

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NOTE: The coating system specified in Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES is very robust and should always be allowed. It includes the following:

Abrasive blast prep per SSPC SP 10/NACE No. 2

Zinc-Rich Epoxy Primer Coat; 3-5 mil

Epoxy Intermediate Coat; 3-5 mil

Polyurethane Topcoat; 2-3 mil.

Insert the following into Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES, Surfaces To Be Coated:

Section 08 34 16 CORROSION CONTROL HANGAR DOORS references Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES and requires shop application of these coatings.

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2.3.1 Ferrous Metal

Clean, prepare, and coat all exposed and non-exposed ferrous metal surfaces as part of the Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES work, including all requirements, submittals, certifications, testing, and inspections required by Section 09 97 13.27. Do not coat finished bearing surfaces. Alternate coating systems or products will not be considered. Prepare surface and apply coatings in the shop, following all temperature, humidity, and testing requirements listed in the Section 09 97 13.27. After installation of the door, prep and touch up surfaces damaged during assembly and installation of the door. Prep and coat unfinished ferrous metal accessories such as bolts and brackets.

2.3.2 Factory-Finished Panels

All factory-finished ferrous metal panels to be exposed to the interior or exterior shall be galvanized G90 per ASTM A653/A653M and coated with a PVDF fluoropolymer equal to Kynar 500.

2.4 SINAGE

Provide a placard sign immediately adjacent to the controls explaining how to operate the door and indicating the following:

a. Notice

(1) Doors must be closed and not operated when wind speeds above 96.6 km/hr 60 mph are expected.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

The installation of the assemblies shall be performed by workmen skilled in this type of work in accordance with the approved shop erection drawings and procedures. Use erecting equipment suitable for the work and in fully operable condition. Report immediately to the CQC Representative if parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation. Obtain approval of the method of correction from the CQC Representative, and make correction in his presence. Use approved methods to straighten plates, angles or other structural shapes.

3.2 ERECTION

Assemble doors and accessories in accordance with approved shop drawings. Do not erect doors until the work of other trades in preparing the opening has been completed and the hangar roof is completed and under full dead load.

3.2.1 Erection Procedure

Include in the erection procedure complete description of the material handling equipment and accessories and the methods which will be used to assure that individual assemblies will not twist, buckle, deform or otherwise be damaged during the handling and erection. Describe the method of alignment and leveling of the rails including equipment to be used. Describe the method of alignment of the door structure with respect to the pivots, locks and seals of the building.

3.2.1.1 Templates

Furnish steel templates and installation instructions, including placing drawings, for setting the anchor bolts for the door rail and embedded lock pin receptacles. The manufacture of the door shall ascertain that these items are properly set prior to the installation of the rails and the erection of the doors.

3.2.1.2 Door Rails

Anchor door rails to the concrete support base as indicated using the double nut method on anchor bolts for adjusting and setting elevation. Weld all rail joints and grind smooth. Set rails to indicated radius within a tolerance of plus or minus 0.79 mm 1/32 inch. Place non-shrink grout to provide continuous positive contact with the underside of the rails. After the non-shrink grout has cured, and after the rail grounds provided under 26 20 00 INTERIOR WIRING SYSTEMS are installed, and after door and drive assemblies have been checked for alignment and fit, fill

the remainder of rail recess in the concrete base with concrete. Conform to 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.1.3 Door Bottom Lock Pin Receivers

Locate lock pin receiver assemblies accurately and set to elevation indicated plus or minus 0.79 mm 1/32 inch using the double nut method on the anchor bolts. Protect spring assembly during placement of concrete to prevent damage or entry of foreign matter.

3.2.1.4 Door Leafs

Field erect door leafs in accordance with approved shop erection drawings after: the rails have been installed and checked for alignment and grade; the bottom pivot base assembly has been installed and checked for alignment and grade; and the lock pin receiver assemblies have been installed and checked for location and grade. First install lower assembly of each door leaf on the bottom pivot with the drive wheel on the rail. After checking for fit, erect and mate the upper assemblies to the lower assembly and the top pivot. Before installing the siding, concrete base fill, filter bank and seals, manually operate each door leaf through the total of 90 degrees of travel to check for final alignment, fit and freedom of movement of the pivots with no binding. After confirmation of the proper movement of each door leaf, permanently locate all limit switches and secure. Place concrete fill, followed by the siding, flashing and seals. Make all electrical and compressed air connections with the building services. Commission and test the drive mechanism and lock pin mechanisms. Perform installation to assure that the equipment will function properly for its intended purpose in conformance with the requirements of the drawings and specifications. After installation has been completed, the Contractor shall perform such final adjustments, operational testing, and cleaning to assure conformance with the requirements specified herein.

3.2.1.5 Compressed Air Tubing

Run tubing in maximum lengths possible without breaks or fittings. Install tubing runs and bends free of kinks, ripples or flattened surfaces. Align tubing with connectors before connections are made. Male appropriate union fittings for tubing connections to accessories and devices to permit removal of the item without removal of the tubing. Before final connection to the air system accessories and cylinders, clean and pressure test entire air piping system leaks in accordance with section 43 15 00.00 20 LOW PRESSURE COMPRESSED AIR PIPING (NON-BREATHING AIR TYPE).

3.2.1.6 Electrical

Install and wire electrical power and control systems, including the motion annunciators (horn and light), and limit switches. Adjust location of each limit switch and set in proper position.[The electrical installation within the doors and on the interior faces of the doors for Class 1, Division 1, Group D hazardous areas shall conform to NFPA 70 requirements.] Make watertight installation of electrical on the outside of doors. Make the SO power and control cables between the building interface junction boxes and the door of sufficient length to permit full travel of the doors without tangling or binding. Wire exit light as indicated. All wiring within the building including the interface junction boxes on the building will be performed under 26 20 00 INTERIOR

DISTRIBUTION SYSTEM.

3.2.1.7 Touch-Up Coating

After installation of the door, the same installer that performed the initial coating prior to assembly and erection shall prep and touch up surfaces damaged during assembly and installation of the door as well as unfinished ferrous metal accessories per the requirements listed in Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES and per this Section.

3.3 FIELD INSPECTION AND TESTS

The Contractor Quality Control Representative shall perform all field inspections and tests specified herein at the Contractor's expense.

3.3.1 Inspection General

Inspection shall continue during receipt and off-loading of door components and during erection. Make an inspection of the fabricated components prior to installation to determine conformance with the specifications and approved shop drawings. Correct or replace all rejected material to the satisfaction of the CQC Representative.

3.3.2 Manufacturer's Field Engineer

The manufacturer of the hangar doors shall provide a qualified field engineer to supervise the installation and perform the inspection services specified hereinafter. The field engineer shall furnish duplicate copies of his report to the Contractor Quality Control Representative within 24 hours following each inspection. The Contractor shall furnish a copy of the field inspection engineer's report to the CQC Representative within 48 hours and shall perform the following:

a. Inspect doors during job site unloading, sub-assembly and prior to erection.

b. Inspect installation of rails and other embedded items before pouring of fill concrete to ensure that the elevation and alignment indicated have been complied with and that rails are level to the specified tolerance.

c. Recheck rails and other embedded items to verify the accuracy of dimensions.

d. Provide recommendations for any necessary corrective action.

e. Inspect final erection and assembly of door leafs for alignment and fit, and clearance between doors and building, and between door and leafs.

f. Inspect setting of all seals in the closed position to assure an airtight installation.

g. Inspect the positioning and fit of pivot assemblies.

h. Inspect the mating of lock pins with receptacles.

i. Inspect all fasteners to assure that all screws and bolts are properly

secured to prevent loosening.

j. Inspect all field welds in accordance with AWS D1.1/D1.1M.

k. Check all drive assemblies and lock pins for smooth operation and that all lubrication has been accomplished.

l. Check that final sealing provides an airtight plenum.

m. Verify that all gear boxes and bearings have been lubricated.

n. Supervise the testing, including the balancing of the air flow specified herein.

3.3.3 Operation

Install doors for smooth operation, providing indicated clearance and seal with the building. Door shall not bind or damage sealing mechanism while being opened or closed. Door shall be free of twists.

3.3.4 Tests

Upon completion of the installation, subject doors to operational tests. When all necessary corrections have been accomplished, advise the CQC Representative. CQC Representative will schedule a final inspection and test. Furnish all instruments, labor and materials required for test. The Manufacturer's field engineer shall be present to conduct the test. Test each door leaf for the full extent of its travel in both directions and check to assure that there is no conflict when both leafs are operated simultaneously. Power operate each door leaf through twenty cycles to measure travel time. Test doors to demonstrate manual opening and closing, and unlocking without electric power. Demonstrate the distribution of the ventilation supply air through the diffuse and filter assemblies for uniformity of velocity.

3.3.5 Corrections

Adjust doors failing to operate properly.

3.4 PERSONNEL EQUIPMENT SYSTEMS ORIENTATION

Provide orientation and instruction of Government plant personnel in the operation and maintenance of the doors, mechanical drive system, locking systems and pivot system. Provide a factory trained representative to conduct formal classes at the facility for one eight-hour period during the final check-out and acceptance stages for the entire door system, after the receipt by the Government of approved operation and maintenance manuals.

-- End of Section --