UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 34 16.10

STEEL SLIDING HANGAR DOORS

05/17

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 DESIGN REQUIREMENTS
1.3.1 Door Design and Components
1.3.1.1 Steel Door Components
1.3.2 Loads
1.3.2.1 Wind Loads
1.3.3 Deflections
1.3.4 Connections
1.3.5 Cold-Formed Steel Members
1.4 QUALITY ASSURANCE
1.4.1 Manufacturer's Qualifications
1.4.2 Installer's Qualifications
1.4.3 Warranty
1.5 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

2.1 HANGAR DOORS
2.1.1 Structural Steel
2.1.2 Formed Steel
2.1.3 Galvanized Steel
2.1.4 Sheet Steel
2.1.5 Galvanized Sheet Steel
2.1.6 Exterior Covering
2.1.7 Interior Covering
2.1.8 Insulation
2.1.9 Hardware
2.1.9.1 Wheel Assemblies
2.1.9.2 Fixed Pancake Top Guide Rollers
2.1.9.3 Vertical Floating Head Top Guide Rollers
2.1.10 Personnel Doors
2.1.10.1 Doors and Frames
2.1.10.2 Hardware for Personnel Doors

2.1.10.3 Electrical Interlock
2.1.11 Weather Stripping
2.1.11.1 Neoprene
2.1.11.2 Metallic
2.1.11.3 Hanging Head Flashing
2.1.12 Fasteners
2.1.13 Sealant
2.1.14 Primer
2.1.15 Starters
2.1.16 Electrical
2.2 FABRICATION
2.2.1 Doors
2.2.1.1 Frames and Framing
2.2.1.2 Exterior Covering and Interior Liner Sheets
2.2.2 Locking Devices
2.2.3 Tractor Pulls
2.2.4 Track Cleaners
2.2.5 Insulation
2.2.6 Cable System for Group Doors
2.3 OPERATION
2.3.1 Hangar Door Types
2.3.1.1 Individually Operated Doors
2.3.1.2 Floating Group Doors
2.3.1.3 Anchored Group Doors
2.3.2 Operating Units
2.3.3 Braking Systems
2.3.4 Controls
2.3.4.1 Push Buttons for Individually Operated Doors
2.3.4.2 Push Buttons for Floating Group Doors
2.3.4.3 Push Buttons for Anchored Group Doors
2.3.5 Limit Switches
2.3.5.1 Plunger-Type Limit Switches
2.3.5.2 Lever Arm Type Limit Switches
2.3.6 Safety Edges
2.3.6.1 Electrical Safety Edges
2.3.7 Warning Device
2.3.8 Emergency Operation
2.3.9 Electrical Work
2.3.9.1 Trolley Ducts
2.3.9.2 Electrical Cables
2.4 FINISHES
2.4.1 Ferrous Metal
2.4.2 Factory-Finished Panels
2.5 SIGNAGE

PART 3 EXECUTION

3.1 ERECTION
3.1.1 Touch-Up Coating
3.2 FIELD QUALITY CONTROL
3.2.1 Manufacturer's Field Services
3.2.2 Tests
3.3 ELECTRICAL WORK

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA | **UFGS-08 34 16.10 (May 2017)**

Preparing Activity: NAVFAC | **Superseding UFGS-08 34 16.10 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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SECTION 08 34 16.10

STEEL SLIDING HANGAR DOORS
05/17

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NOTE: This guide specification covers the requirements for steel sliding hangar doors, their operators, and controls.

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).

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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.

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NOTE: Steel rails, top guides, hanging head flashing, field painting, and electrical work for hangar doors are specified in other sections.

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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 not less than 350 mm 14 inches, and not less than 115 mm 4 1/2 inches greater than total thickness of each leaf, including interior and exterior coverings. Where electrical trolley duct is required between leaves, provide additional 150 mm 6 inches of clearance. Where cable system is required between leaves, provide additional 25 mm one inch of clearance.

4. Location and type of personnel doors. Do not locate personnel doors between wheels and edge of hangar door leaf. Exact location to be determined by structural design of 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 paragraph WIND LOADS for more detailed requirements. Positive and negative deflection of top guides due to live loads.

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. Festooned or draped cables or cable reels.

11. Access for installation, maintenance, and replacement of top rollers if hangar requires floating top rollers.

12. Door pockets: Minimum of 450 mm 18 inches for doors up to 300 mm 12 inches thick, 800 mm 32 inches for doors more than 300 mm 12 inches thick, should be allowed from center line of power leaf rail to farthest projection of interior wall of door pocket to accommodate operators and provide access.

13. Dimensions and details of tail doors, if required.

14. Minimum clearance of 100 mm 4 inches between extreme faces of adjacent leaves in vicinity of interconnecting cables to allow sufficient space for cable sheaves and cable pickup.

15. Clearance of 100 mm 4 inches between metal parts on vertical edges of leaves and between leaves and jambs which are weather-stripped.

16. Pocket depth, equal to width of widest door leaf, plus 900 mm 3 feet net clearance for cable sheave brackets extending beyond trailing edge of leaves.

17. Rail drains for full length of bottom rails. This may be done with cross drains normal to the rails spaced at a maximum of 3000 mm 10 feet o.c., emptying into continuous parallel floor drain. In cold areas it may be necessary to provide defrosting equipment below rails.

18. End of travel bumpers and bumper supports at end of door travel. Dimensions and locations should be in accordance with door manufacturer's approved drawings.

****

PART 1 GENERAL

1.1 REFERENCES

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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.

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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 SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

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

ASTM INTERNATIONAL (ASTM)

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 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 C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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 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

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-200-01	(2019) DoD Building Code
UFC 3-301-01	(2019) Structural Engineering

UNDERWRITERS LABORATORIES (UL)

UL 506	(2017) UL Standard for Safety Specialty Transformers

1.2 SUBMITTALS

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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 sealed by the Door Manufacturer's Registered Professional Engineer

Hangar doors; G[, [_____]]

Submit the door manufacturer's complete schematic wiring diagram, field wiring diagram, and a complete physical location drawing showing the location of controls with the runs of conduit, size of conduit, number and size of wires in each conduit, location of junction boxes, and full details of control mountings.

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

SD-05 Design Data sealed by the Door Manufacturer's Registered Professional Engineer

Hangar doors; G[, [_____]]

Submit design drawings and structural, mechanical, and "U" value calculations.

SD-10 Operation and Maintenance Data

Hangar doors, Data Package 2; G[, [_____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Include wiring and control diagrams.

1.3 DESIGN REQUIREMENTS

1.3.1 Door Design and Components

The Steel sliding hangar doors and components dictated 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.

1.3.1.1 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.

1.3.2 Loads

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

1.3.2.1 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 steel sliding 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 psf on the surface of the door.

1.3.3 Deflections

For any door member, the deflection due to design wind load shall not exceed the member's length divided by 120.

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

1.3.4 Connections

Design connections at top and bottom guide rails to withstand both the positive and negative design wind pressures. Design for an inward and outward seismic force according to the requirements for exterior nonstructural wall elements and connections in ASCE 7-16. The governing force (wind or seismic) must be concurrent with the door self-weight and must be factored according to ASCE 7-16 load combinations.

1.3.5 Cold-Formed Steel Members

Cold-formed steel main members and girts shall be not less than 6 mm 1/4 inch thick.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer's Qualifications

Use a steel sliding hangar door product from a manufacturer who is regularly engaged in the design, fabrication, erection, and service of steel sliding hangar doors of type and size required for this project. The manufacturer shall have at least 5 years of similar steel sliding 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 steel sliding hangar doors of the type specified herein. Installers must submit written evidence of similar past door installations listing the name, locations, contact 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, STORAGE, AND HANDLING

Deliver materials which are not shop installed on the doors in original rolls, packages, containers, boxes, or crates bearing the manufacturer's name, brand, and model number. Store materials and equipment in dry locations with adequate ventilation, free from dust and water, and so as 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.

PART 2 PRODUCTS

2.1 HANGAR DOORS

2.1.1 Structural Steel

****

NOTE: Specify stainless steel only if local experience indicates that steel guides will rust and interfere with door operation.

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."

****

AISC 360 and ASTM A36/A36M.

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 steel sheet, commercial quality,
ASTM A1008/A1008M cold-rolled steel sheet, commercial quality.

2.1.5 Galvanized Sheet Steel

ASTM A653/A653M, coating designation G 90 galvanized steel sheet, commercial quality.

2.1.6 Exterior Covering

****

NOTE: Choose one of the following options.

****

****

NOTE: Designer's options. Use the first paragraph if the covering is to be provided by the hangar door manufacturer, as when new doors are required for an existing building. Use the second paragraph if the hangar doors are a part of a new building which will have preformed metal siding. Ascertain that the project specification contains the referenced section and that the section is edited to include the covering for the hangar doors.

****

[Flat [sheet steel] [galvanized steel sheet], not thinner than 2.15 mm thick 13 gage.

][Preformed metal siding as specified in Section 07 42 13 METAL WALL PANELS

with factory finish equal to Kynar 500 PVDF fluoropolymer.

]2.1.7 Interior Covering

****
NOTE: Choose one of the following options.
****

****
NOTE: Designer's Options. Use the first paragraph if the covering is to be provided by the hangar door manufacturer, as when new doors are required for an existing building. Use the second paragraph if the hangar doors are a part of a new building which will have preformed metal liner panels. Ascertain that the project specification contains the referenced section and that the section is edited to include the covering for the hangar doors.
****

[Flat [sheet steel] [galvanized steel] liner sheets, not thinner than 1.5 mm thick 16 gage.

][Preformed metal siding is specified in Section 07 42 13 METAL WALL PANELS with factory finish equal to Kynar 500 PVDF fluoropolymer.

]2.1.8 Insulation

****
NOTE: Choose one of the following options.
****

****
NOTE: Designer's Options. Use the first bracketed item if the insulation is to be provided by the hangar door manufacturer, as when new doors are required for an existing building. Use the second bracketed item if the hangar doors are a part of a new building which will have preformed metal siding and liner panels. Ascertain that the project specification contains the referenced section and that the section is edited to include the insulation for the hangar doors.
****

****
NOTE: Specify same "U" value as required for walls of the building. Specify STC value as required to keep noise level within the hangar at not more than 85 dBa. The value will depend upon type of aircraft, apron traffic patterns, and proximity of run-up areas.
****

[Provide insulation that:

a. Contains no asbestos;

b. Is permanently secured in place behind the exterior covering; and

c. Has 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 as exposed finish material. The doors shall have an air-to-air "U" value of not more than [_____] and a sound transmission class (STC) of not less than [_____].

][Batt or blanket insulation as specified in Section 07 21 16 MINERAL FIBER BLANKET INSULATION.

]2.1.9 Hardware

Provide hangar door hardware to accommodate actual dead loads plus wind loads specified. Provide top guide rollers, bottom wheels, interleaf bumpers, tractor pulls, track cleaners, and top bumpers as required for a complete and operational installation.

2.1.9.1 Wheel Assemblies

Bottom wheels shall be of steel plate or cast steel, having a minimum tread diameter as required for the actual wheel loading. Where the height-to-width ratio of the door leaf exceeds three, wheel assemblies shall be vertically adjustable. Construct wheel assemblies to permit removal of the wheel without removing the door leaf from its position on the rail.

a. Treads: Machine wheel treads concentric with bearing seats. The clear distance between flanges shall not exceed the width of the rail by more than 3 mm 1/8 inch at the tread nor more than 6 mm 1/4 inch at the edge of the flange. Machine internal bearing seats accurately for a press fit. Heat treat wheels 450 mm 18 inches or greater in diameter to obtain a rim hardness of 320 Brinnel.

b. Wheel bearings: Provide tapered roller or spherical bearings, either internal or cartridge type, arranged so that both horizontal and vertical loads shall be transferred to the rail only through the bearing. Bearings shall be tightly sealed and equipped with high-pressure grease fittings.

2.1.9.2 Fixed Pancake Top Guide Rollers

****
NOTE: Specify stainless steel rollers only if local experience indicates that steel rollers will rust and interfere with door operation.
****

Horizontal type; each with single or double steel rollers of a suitable diameter and thickness for satisfactory performance under the designated load conditions and top guide system used. Provide permanently lubricated bearings. [Rollers shall be stainless steel.]

2.1.9.3 Vertical Floating Head Top Guide Rollers

Provide top-roller assemblies to:

a. Move up and down within the specified live load positive and negative deflection of the roof in the vicinity of the door opening;

b. Allow easy removal through the top of the guide system; and

c. Include both horizontal and vertical rollers built into a frame which is connected in such a manner as to transmit the specified wind loads from the door to the hangar structure and to prevent disengagement of the door from the top guide.

[Rollers shall be stainless steel.

]2.1.10 Personnel Doors

****
NOTE: Personnel doors, their frames, and hardware shall be specified in the respective sections of the project specification. Provide self closing door hardware. Personnel doors in hangar doors are often part of the flight line security perimeter locking behind someone exiting through the hangar door and may, or may not have exterior door pulls. Address getting back into the hangar from the flight line when the hangar doors are all closed, especially on large long hangars.
****

The hangar door manufacturer shall provide structural frames and electrical interlock for personnel doors.

2.1.10.1 Doors and Frames

Specified in Section 08 11 13 STEEL DOORS AND FRAMES.

2.1.10.2 Hardware for Personnel Doors

Specified in Section 08 71 00 DOOR HARDWARE.

2.1.10.3 Electrical Interlock

Provide each personnel door with an electrical interlock switch to prevent motor operation of the leaf or group in which it is located when the personnel door is open. Provide an identified indicator light at each door leaf control station indicating when the personnel door is in the open position.

2.1.11 Weather Stripping

Provide adjustable and readily replaceable material. Provide [as indicated] [on vertical edges, sills, and heads] to afford a weathertight installation.

2.1.11.1 Neoprene

Use flap-type, two-ply, cloth-inserted neoprene or extruded, double flap, single or dual opposed solid neoprene material on vertical edges and sills. The two-ply material shall have a minimum thickness of 3 mm 1/8 inch and shall be retained continuously for its full length and secured with rust-resistant fasteners 300 mm 12 inches o.c. Extruded weather stripping with heavy center section shall be attached at 300 mm 12 inches o.c., but continuous bar may be omitted. Clearance between metal parts on

vertical edges of leaves and between leaves and jambs which are to be weather-stripped shall be as indicated.

2.1.11.2 Metallic

Form head weather stripping material between each leaf and the top guide system of not thinner than 1.2 mm thick 18 gage galvanized sheet steel or flap-type, cloth-inserted neoprene, as indicated.

2.1.11.3 Hanging Head Flashing

****
NOTE: Delete paragraph if hangar doors have vertical floating top rollers. Hanging head flashing must be designed and fabricated to accommodate total positive and negative deflection of roof in vicinity of door opening. Stiffened hanging head flashing shall be designed to fasten to top guides; material shall be 2.15 mm 13 gage galvanized steel stiffened by supporting frames to adequately withstand specified wind loads without permanent deformation. Material must be furnished and installed by same trade that furnishes top guide system, so preparation for fasteners can be done at fabrication shop. However, to minimize possibility of damage to the material, installation must be done after doors are in final position on rails.
****

Provide with the top guide system specified in Section 05 12 00 STRUCTURAL STEEL. Provide cloth-inserted neoprene weathering fastened to top of door leaves to engage the head flashing when doors are closed.

2.1.12 Fasteners

Hot dipped galvanized.

2.1.13 Sealant

Single-component or multicomponent 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 types of substrate to which it will be applied.

2.1.14 Primer

Zinc-Rich Epoxy Primer per Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES.

2.1.15 Starters

Provide magnetic reversing starters in NEMA ICS 6, Type 12 enclosures equipped with access door-controlled, fused safety disconnect switches. Starters shall be factory wired with overload and undervoltage protection, mechanical and electrical interlocks, auxiliary contacts, relays and timing devices as required, control circuit transformers, and a numbered terminal strip. The control circuit transformer shall reduce the voltage in the control circuits to 120 volts or less, and shall conform to UL 506.

2.1.16 Electrical

Provide conduit, wire, flexible cables, boxes, devices, and accessories[, and install trolley duct,] under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. If permanent electrical power is not available when door installation is complete, provide temporary power in accordance with distribution system requirements in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, for testing and adjusting the doors.

2.2 FABRICATION

2.2.1 Doors

2.2.1.1 Frames and Framing

Door leaves shall be of welded or bolted construction. Joints shall develop 100 percent of the strength of the framing members. Vertical members shall be continuous throughout the height of the door. When required, prepare splices to facilitate field assembly in accordance with standard practice. Frames and framing members shall be 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 one mm in 2 meters 1/8 inch in 20 feet. Provide diagonal bracing so that the completed leaf assembly will be braced to withstand shipping, assembly, and operational loads. Exposed welds and welds which interfere with the installation of various parts such as cover sheets shall be ground smooth. Prepare, prime, and coat structural framing and miscellaneous steel as specified in paragraph FINISHES.

2.2.1.2 Exterior Covering and Interior Liner Sheets

Flat sheets shall be fastened to the frame either by edge welding, plug welding, or threaded fasteners 300 mm 12 inches o.c. Where flat sheets are attached as either exterior covering or interior liner sheets, the clear unsupported area shall not exceed 2.5 square meters 25 square feet. Make edges of exterior sheets weathertight with sealant.

2.2.2 Locking Devices

Do not provide locking devices on motor-operated hangar doors.

2.2.3 Tractor Pulls

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

2.2.4 Track Cleaners

Provide a device to clear debris from the rail head and wheel flange grooves as the leaf is moved.

2.2.5 Insulation

Secure insulation to doors with clips, studs, or adhesive. Protect insulation within 2400 mm 8 feet of floor with steel liner sheets secured to framing 300 mm 12 inches o.c.. at edges with hot dipped galvanized, self-tapping screws.

2.2.6 Cable System for Group Doors

The minimum size for the cable which interconnects the leaves shall be 10 mm 3/8 inch; the cables shall be improved plow steel with lubricated hemp centers or wire rope cores. Sheaves over which the cables operate shall have a diameter of at least 18 cable diameters and either sealed ball-or roller-type bearings or graphite bronze bearings of a sufficient capacity for the operating loads. Grease fittings shall be provided for the sheave bearings unless permanently lubricated bearings are used.

2.3 OPERATION

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NOTE: Door type, operation and control will depend upon use and configuration of the hangar. Choose one of the 3 types of operation in the paragraphs below compatible with the design requirements.

NOTE: See UFC 4-211-01 - Aircraft Maintenance Hangars for limitations on types, operation and control of Steel Sliding Hangar Doors allowed for aircraft maintenance hangars.

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2.3.1 Hangar Door Types

Hangar doors shall be [unidirectional] [biparting] [as indicated].

2.3.1.1 Individually Operated Doors

Each door leaf shall have a separate, traction-drive operating unit driving one or more of the bottom wheels. Each leaf shall have a motor-mounted, spring-set, solenoid-released motor brake. Each leaf shall move independently of the other leaves. Provide doors that require operating personnel to walk with the leaf as it moves.

2.3.1.2 Floating Group Doors

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NOTE: Consider visual appearance when using the anchored or wraparound cable system. The cables used to move the door leaves are exposed to view.

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[Each group of three or more leaves shall have a separate, traction-drive operating unit located in each end leaf of the floating group doors, which drives one or more wheels of the end leaf, and a wraparound cable system on the intermediate leaves coupled to each end leaf; or an interleaf pickup system. Movement of either end leaf shall allow stacking and unstacking of the other end and shall also allow intermediate leaves to move in concert. The group of leaves traveling abreast may then be positioned as desired in the opening. Provide necessary cables, fittings, cable sheaves, housings, guards, pickups, brackets, anchors, and miscellaneous hardware.

]2.3.1.3 Anchored Group Doors

[Each group of leaves shall have a traction-drive operating unit located in

the lead leaf of the group and driving one or more wheels of the lead leaf.[The leaves in each group shall start to move at the same time and arrive at their fully open or fully closed positions simultaneously.] Provide necessary cables, fittings, sheaves, housings, guards, pickups, brackets, anchors, and miscellaneous hardware.

]2.3.2 Operating Units

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NOTE: Delete "lead" for individually operated doors. Leave in for group doors.

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.

****

Each operating unit shall move its [lead] leaf at a speed of approximately 20 meters 60 feet per minute at zero wind load conditions and to be operable up to and including a maximum wind load of 0.718 kilopascals 15 pounds per square foot. The operating units shall consist of either a separate motor and gear reducer or a gearhead motor, high-speed shaft brake, and necessary roller chains and sprockets. The systems shall be provided with overload protection for the drive units and a means for emergency tractor towing operation.

a. Motors shall be NEMA MG 1, high-starting torque, reversible type with sufficient horsepower and torque output to operate the leaves in either direction from any position under zero wind load conditions at not more than 75 percent of their rated capacity. Motors shall operate on current voltage of the characteristics indicated at not more that 3600 [1800] rpm. Motor enclosures shall be drip-proof type or NEMA totally-enclosed, fan-cooled (TEFC) [totally-enclosed, wash-down (TEWD)] type. Motors shall have a minimum service factor of 1.2.

b. Gear reduction units shall allow a reversal of effort through the gears without damage to the units.

c. Operating mechanisms shall be covered on the interior of the leaf by a hinged 1.5 mm thick 16 gage flat steel cover.

2.3.3 Braking Systems

Braking systems shall be designed to ensure stoppage of the leaves under normal, dry rail conditions within the safety edge overtravel limit. The braking systems shall be either a magnetic, spring-set, solenoid-released brake or hydraulic type. Provide a hand release to release the brake when it becomes necessary to move the leaf with an outside force. The hand release shall be an automatic reset type so that the brake will be operable during subsequent electrical operation of the door.

2.3.4 Controls

Doors shall be controlled by constant pressure push buttons mounted on the door leaves. Removing pressure from the button shall stop the movement of the leaves. The control equipment shall conform to NEMA ICS 1 and NEMA ICS 2. Interior push buttons shall be mushroom head type, mounted in

heavy-duty, oil-tight enclosures conforming to NEMA ICS 6, Type 13, except that enclosure for reversing starter with disconnect switch shall be Type 12.[Exterior push buttons shall be in watertight enclosures conforming to NEMA ICS 6, Type 4.]

2.3.4.1 Push Buttons for Individually Operated Doors

The leaves mounted on the outer rails shall have the push buttons mounted on the exterior face; the leaves on the inner rails shall have the buttons mounted on the interior face; and the leaves on the middle rails shall have the buttons mounted on both the exterior and interior faces. The button at each edge of a leaf shall allow the leaf to travel with that edge as the leading edge only. The controls shall not be reversible. Location of each control button shall be as indicated.

2.3.4.2 Push Buttons for Floating Group Doors

Each group shall be controlled by push button stations mounted at each end of each group of leaves. Stations shall contain one button for stacking the leaves, one button for unstacking the leaves, and a third button for moving the leaves in a group. The leaves mounted on the outer rail shall have the push buttons mounted on the exterior face. The leaves mounted on the inner rail shall have the push buttons mounted on the interior face. Location of each control station shall be shown on manufacturer's drawings.

2.3.4.3 Push Buttons for Anchored Group Doors

Each group shall be controlled by a two-button push button station marked "OPEN" and "CLOSE" mounted near the inside leading edge of the lead leaf.

2.3.5 Limit Switches

Provide limit switches to prevent overtravel and bumping. Safety edges shall not be used as limit switches.

2.3.5.1 Plunger-Type Limit Switches

Provide [at each edge of each leaf of individually operated doors] [at each end of each group of floating group doors]. Limit switches shall be actuated by 20 mm 3/4 inch diameter stainless steel rods of adjustable length, guided at both ends with nonmetallic bearings and with tape-type constant force springs to return the rods to their normal position after actuation. The actuating rods shall have sufficient overtravel so that the leaves cannot bump one another or any portion of the building or be damaged when being towed. Each rod shall be adjustable 6 inches plus or minus from its normal position.

2.3.5.2 Lever Arm Type Limit Switches

Provide for anchored group doors to stop the travel of each group in the fully open and fully closed positions. The limit switches shall be:

a. Positive acting, snap action, lever arm type with actuating cams designed with sufficient overtravel to permit the group to come to a complete stop without overtraveling the limit switches.

b. Mounted on the leaves, and the actuating cams mounted either on the top guides or on adjacent door leaves.

2.3.6 Safety Edges

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NOTE: Edit to suit type of door operation required.
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Provide fail-safe safety edges on [each edge of each leaf of individually operated doors] [each leading and trailing edge of drive leaves for floating group doors] [the leading edge of the drive leaf of anchored group doors] from 25 mm one inch above the floor to the top of the door leaf. For leaves 300 mm 12 inches thick (including siding) or less, provide a single run of safety edge the full width of door. For leaves over 300 mm 12 inches thick (including siding,) provide a double run of safety edge spaced to provide the maximum degree of safety in stopping the leaves. For leaves over 300 mm 12 inches thick (including siding) provide a double run of safety edges on the outer edge of each side of door leaf covering no less than 80 percent of leaf.

a. Design: Provide safety edges to provide a minimum of 90 mm 3-1/2 inches of overtravel after actuation until solid resistance is met and door motion comes to a complete stop. If door requires more than 90 mm 3-1/2 inches to come to a complete stop, provide additional overtravel built into safety edge the distance required for door motion to come to a complete stop. Use electric safety edges.

b. Specs: Use sensing edges of reinforced polyvinyl chloride cover or other Government-approved material with chemical resistance to diesel and JP-4 fuel, hydraulic fluids, SAE-30 oil and salt water. Use cover that provides hermetic seal for weather and moisture resistant protection of internal foam and contact elements. Internal foam may be polyurethane and/or latex foam per military specification MIL-R-5001, medium density. Use two contact elements separated by perforated foam or other Government -approved materials and design to perform the switching function when the sensing edge encounters an obstruction along any portion of its active length.

c. Operation: Actuation of the safety edge on leading edge of a group of leaves shall stop movement of the group. Actuation of a safety edge shall lock out the motor control in the direction of travel until reset, but shall permit the door to be reversed away from the obstruction which tripped the safety edge. Safety edges shall be alive only when doors are moving. Safety edges shall be reset by moving doors away from the obstruction. The lower portion of the safety edges to a height of approximately 1500 mm 5 feet shall be independently removable for convenience in servicing or repair. The remainder of the edge may be in one piece up to a maximum of 6000 mm 20 feet.

d. Bumper(s): Each door leaf edge provided with a safety edge shall be protected by a spring type bumper(s). Bumper shall be designed to absorb 150 percent of the door drive force when door is pushed in an emergency. For continuous safety edges, bumpers shall extend to the sides. For sectional safety edges, the bumper can interrupt the safety edge for a distance not greater than 305 mm 12 inches.

e. Keyed bypass: Provide a keyed bypass to the door controls to render the safety edges in a temporary "repair" mode, if necessary. The door drive shall be restored from its "fail safe" mode by activation of the keyed bypass.

2.3.6.1 Electrical Safety Edges

Connect the safety edge in series with the necessary relays and resistors to make the system complete. The service shall be not more than 24 volts and the circuit shall be normally energized so that the malfunction of any of the component parts will make the door inoperative. Wire sensing edges to provide for control reliable 4-wire operation of hangar door so that any power loss to the sensing edges is experienced, then the door becomes inoperable until power is restored and a reset operation is initiated. Install sensing edges to operate through a normally energized relay so that when the sensing edge is compressed the relay contacts open. Install relay contacts to also open if any component in the sensing edge control circuit is broken so as to break continuity. Use 24 volts electrical service to the control circuit. Ensure service to the sensing edge does not exceed a nominal 24 volts. Install a large red indicator light and/or a loud siren, to be simultaneously activated with the actuation of any sensing edge, to indicate the presence of an obstruction.

2.3.7 Warning Device

Provide a clearly audible signal on each [individually operated leaf] [group of leaves]. The warning device shall:

a. Operate when the push button is actuated for movement of the door in either direction;

b. Sound 5 seconds before the door moves, and while the door is moving; and

c. Consist of not less than a 150 mm 6 inch diameter bell or equivalent decibel-rated horn, loud enough to be heard in the hangar and on the apron.

d. Have a distinct warning sound that is different than all other warning system sounds in the hangar bay.

2.3.8 Emergency Operation

Hangar doors[, including tail doors,] shall be constructed and equipped so that they can be operated-manually or by tractors from the hangar floor in case of power failure. Manual operation of hangar doors shall be designed to avoid damage to safety edges.

2.3.9 Electrical Work

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NOTE: Insert the following into Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

"HANGAR DOORS: Provide field wiring[and trolley duct installation] for hangar doors under this section in accordance with door manufacturer's written instructions, drawings and diagrams, and NFPA 70 and NEMA ICS 1. Provide conduit, wiring, boxes, cables, devices, and accessories under this section. If permanent electrical power is not available when door installation is complete, provide temporary power for testing and adjusting

doors for proper operation.[Trolley ducts will be furnished by door manufacturer and installed under this section in accordance with door manufacturer's approved drawings.][Draped or festooned cables or cable reels shall be provided under this section. Cable shall be extra-flexible Type SD, and shall have a spring-loaded, automatic take-up reel, coil-cord, draped cable, or equivalent device.] [as indicated.]"

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The door manufacturer shall provide the proper electrical equipment and controls built in accordance with the latest NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 standards. Equipment, control circuits, and safety edge circuits shall conform to NFPA 70. Where located 450 mm 18 inches or less above the floor, they shall be explosion-proof as defined in NFPA 70, Article 513. Manual or automatic control devices necessary for motor operation of the doors shall be provided, including push button stations, limit switches, combination fused disconnect switches and magnetic reversing starters, control circuit transformers, relays, timing devices, warning devices, and trolley ducts with collectors or trolleys.

2.3.9.1 Trolley Ducts

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NOTE: Individually motor-operated doors and floating group doors should always be provided with a trolley duct system to bring power to door leaves. Anchored group doors, if opening width is not excessive, can be equipped with draped or festooned cables or cable reels. If opening width exceeds 36 meters 120 feet, a trolley duct system should be used. Trolley duct systems should be specified to be furnished by door manufacturer but installed under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM in accordance with door manufacturer's drawings. Only door manufacturer is properly qualified to know where to place trolley duct so there is adequate clearance and noninterference.

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Provide one or more runs of trolley duct as required for the door system provided. Ducts shall have solid copper conductors in a protective steel [or polyvinyl chloride] housing. Locate ducts as shown on door manufacturer's drawings. Provide adequate clearances in the top guide system for the ducts.

a. Each run shall consist of the required number of sections of straight track, a section of dropout track, feed boxes, end caps, couplings, hangers, and other accessories to make the system complete and workable. Provide expansion tracks in each run where the system crosses a building expansion joint in the roof construction and in the top guides.

b. Furnish one track-supported tandem trolley or self-supporting collector for each [individually motor-operated door] [group of doors], complete with spring-loaded brush contacts. Provide trolley pulling brackets and corrosion-protected chains attached from each

side of the pulling bracket to each side of the tandem trolley or support bracket for self-supporting collectors.

2.3.9.2 Electrical Cables

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NOTE: Draped or festooned cables and cable reels should be specified to be furnished and installed under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.
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Flat festoon flexible cables with support track system or cable reels with cable support system shall be provided in accordance with the door manufacturer's approved drawings and wiring diagrams.

2.4 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, paragraph, SURFACES TO BE COATED:

Section 08 34 16.10 STEEL SLIDING 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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2.4.1 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.

2.4.2 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.

2.5 SIGNAGE

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 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, the hangar roof is under full dead load, and the top guide and rail systems are within specified tolerances.

3.1.1 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.

3.2 FIELD QUALITY CONTROL

3.2.1 Manufacturer's Field Services

Provide an authorized representative of the door manufacturer to supervise erection of doors.

3.2.2 Tests

Immediately after the door installation is complete, the door manufacturer or his representative shall perform a complete operating test in the presence of the Contracting Officer. Correct defects disclosed by the test. Retest the doors and adjust them until the entire installation is fully operational and acceptable to the Contracting Officer.

3.3 ELECTRICAL WORK

NFPA 70. Provide all conduit, wiring, and mounting of controls in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

-- End of Section --