UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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05/14

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SECTION 08 34 16.20

VERTICAL LIFT FABRIC DOORS
05/14

****
NOTE: This guide specification covers the requirements for vertical lift fabric doors.

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: These doors are an alternative to traditional horizontal steel sliding doors. Contact the NAVFAC Engineering Innovation and Criteria Office for more information.

The design needs to provide for alternate means of operating doors in the event of loss of power.

As of this writing, the fabric utilized in these doors does not comply with impact-resistance requirements on facilities in "wind-borne debris regions" and do not meet the testing criteria of ASTM E1996/ASTM E1886. Testing is underway to find and develop fabrics that meet these requirements. In "wind-borne debris regions" the designer should investigate if there are fabrics currently available that meet the criteria.

When this specification is used for a fuel cell

maintenance hangar, paint hangar, or corrosion control hangar then the hazardous location could include the vertical lift fabric door electrical drive, limit switches, control panels, and pushbutton stations which must then all be specified to be rated for the hazardous location where electrical equipment is installed.

On the drawings show:

1. **Size and arrangement of doors.**
2. **Preferred location of mullions, mullion pits and mullion swing.**
3. **Electrical and structural provisions for hoists, motors and control center.**
4. **Location and type of any required personnel doors and extent of any non-fabric flat panel door area.**
5. **Appropriate design wind pressures based on the design wind velocity. See the paragraph entitled, "Wind Loads" for more detailed requirements.**

****

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.

ALUMINUM ASSOCIATION (AA)

AA ADM	(2020) Aluminum Design Manual
AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 611	(2014) Voluntary Specification for Anodized Architectural Aluminum
AAMA 2604	(2017a) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

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

AMERICAN WELDING SOCIETY (AWS)

AWS A5.10/A5.10M	(2017) Welding Consumables - Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum-Alloys - Classification
AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum

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 A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM A1023/A1023M	(2019) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D2136	(2002; R 2012) Coated Fabrics -

	Low-Temperature Bend Test
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60034-1	(2017) Rotating Electrical Machines – Part 1: Rating and Performance
IEC 60034-5	(2020) Rotating Electrical Machines – Part 5: Degrees of Protection Provided by the Integral Design of Rotating Electrical Machines (IP Code) – Classification
IEC 60034-6	(1991) Rotating Electrical Machines Part 6: Methods of Cooling (IC Code)
IEC 60034-14	(2007) Rotating Electrical Machines – Part 14: Mechanical Vibration of Certain Machines with Shaft Heights 56 mm and Higher – Measurement, Evaluation and Limits of Vibration Severity
IEC 60204-1	(2016) Safety of Machinery – Electrical Equipment of Machines – Part 1: General Requirements
IEC 60269-1	(2014) Low-Voltage Fuses – Part 1: General Requirements
IEC 60269-2	(2016) Low-Voltage Fuses – Part 2: Supplementary Requirements for Fuses for Use by Authorized Persons (Fuses Mainly for Industrial Application) – Examples of Standardized Systems of Fuses A to K
IEC 60364-1	(2005) Low-voltage Electrical Installations in Buildings - Part 1: Fundamental Principles, Assessment of General Characteristics, Definitions
IEC 60364-5	(2009) Low-Voltage Electrical Installations - Part 5-52: Selection and Erection of Electrical Equipment - Wiring Systems
IEC 60947-1	(2020) Low-Voltage Switchgear and Controlgear – Part 1: General Rules
IEC 60947-2	(2016) Low-Voltage Switchgear and Controlgear – Part 2: Circuit-Breakers
IEC 60947-3	(2020) Low-Voltage Switchgear and Controlgear – Part 3: Switches, Disconnectors, Switch-Disconnectors and Fuse-Combination Units

IEC 60947-4-1	(2018; INT 1 2020; Corr 1 2020) Low-voltage Switchgear and Controlgear, Part 4-1: Contactors and Motor Starters - Electromechanical Contactor and Motor Starters

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
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 5	(2017) Industrial Control and Systems: Control Circuit and Pilot Devices
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
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 79	(2015) Electrical Standard for Industrial Machinery
NFPA 101	(2021) Life Safety 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 98	(2016) UL Standard for Safety Enclosed and Dead-Front Switches
UL 248-1	(2011) Low Voltage Fuses - Part 1: General Requirements
UL 248-12	(2011) Low Voltage Fuses - Part 12: Class R Fuses
UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508	(2018) UL Standard for Safety Industrial Control Equipment
UL 1449	(2014; Reprint Jul 2017) UL Standard for Safety Surge Protective Devices

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 must 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.

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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.

SD-01 Preconstruction Submittals

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

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

SD-02 Shop Drawings specific to this project, sealed by the Door Manufacturer's Registered Professional Engineer

Shop drawings of motors, all electrical control devices, and all electrical control panels, including schematic diagrams, dimensional drawings of control panels, details of control panel installations, internal wiring diagrams of control panels, and wiring diagrams indicating all external connections between control panels and from control panels to remote control devices. Furnish list of materials for all control devices, both inside and remote from control panels including manufacturer's model number, electrical ratings, location, and quantity of each item furnished.

Door Design; G[, [_____]]

Show all vertical lift fabric doors and components, including types, sizes, locations, fabric, supporting, bracing and framing steel and aluminum members, metal gages, fasteners, speed, hardware provisions, signage, installation details, and other details of construction. Include supporting brackets for motors, location of motors, and safety devices. Include personnel door, mullion pit and cover or retractable pin and strike if utilized. Provide details for the closure between bulkhead and doors. Include details for supporting and bracing the door assembly from the structure. Indicate finishes to be used.

SD-03 Product Data

Diagrams, performance curves and characteristic curves of equipment and systems.

Electric Operator; G[, [_____]]

Drive unit system horsepowers, belt type, and locations. Safety arrestor type, test reports, and brake system details.

Motors; G[, [_____]]

Motor characteristics including horsepower, service factor, safety factor and standards compliance.

Doors; G[, [_____]]

Controls; G[, [_____]]

Controls characteristics including all electrical components and devices used in the control system, enclosures, safety devices, transformer size and voltage, and emergency power connection.

Door Fabric; G[, [_____]]

Submit fabric panel samples for weight, strength and color approval.

Surge Protection Device (SPD) data for each incoming/outgoing power feeder and each control circuit; G[, [_____]]

SD-05 Design Data

Calculations sealed by the Door Manufacturer's Registered Professional Engineer; G[, [_____]]

Door Load Diagrams (Open/Closed positions); G[, [_____]]

SD-06 Test Reports

Safety Arrester Operation Test; G[, [_____]]

Door Fabric: ASTM D2136; G[, [_____]]

Door Fabric: ASTM E84; G[, [_____]]

SD-07 Certificates

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

Installers Qualifications; G[, [_____]]

Welding Procedures and Qualifications; G[, [_____]]

SD-09 Manufacturer's Field Reports

Acceptance Testing Procedure and Report; G[, [_____]]

SD-10 Operation and Maintenance Data

Door Operation, Data Package 2; G[, [_____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Including wiring diagrams and the complete manufacturer's instructions for operation and maintenance of the doors, door mullions where indicated, and accessories, including emergency operation, in the event of general building power failure to the doors.

Emergency and Routine Preventative Maintenance Plan; G[, [_____]]

SD-11 Closeout Submittals

Acceptance Testing Procedure and Report; G[, [_____]]

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

1.3 DESIGN REQUIREMENTS

1.3.1 Door Design and Components

The vertical lift fabric 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. Door must operate properly without binding, interference, or damage to the adjacent structure. Door must be of limited combustible construction in accordance with NFPA 220 and NFPA 409.

1.3.1.1 Steel Door Components

All supporting, bracing and framing steel members must be designed by the door manufacturer's registered professional engineer for the specified loads according to the requirements of AISC 325 and AISC 360. Steel welding must be in accordance with the AWS D1.1/D1.1M Standards. Refer to Section 05 12 00 STRUCTURAL STEEL for requirements.

1.3.1.2 Aluminum Door Components

All supporting, bracing and framing aluminum members must be designed by the door manufacturer's registered professional engineer for the specified loads according to the requirements of the Aluminum Association (AA ADM). Aluminum welding must be in accordance with AWS D1.2/D1.2M standards.

1.3.2 Loads

The loads for the design of the door must be in accordance with UFC 1-200-01, UFC 3-301-01 and all other applicable criteria.

1.3.2.1 Wind Loads

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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 vertical lift fabric 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	?	?

Zone	Effective Area (SF)	Max Positive Pressure (PSF)	Max Negative Pressure (PSF)
?	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, doors and all components must be designed to withstand the wind pressures as indicated by the Engineer of Record. All door components must be designed to withstand both the highest positive and negative pressures based on actual tributary area from the wind load indicated.

In addition, doors and all components must be designed 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. Also the door mullions where indicated and jambs must be designed for an unbalanced positive or negative service load pressure of 0.718 kPa 15 psf load on the surface of a closed adjacent door with the other adjacent door being open.

Calculations sealed by the door manufacturer's registered professional engineer must be submitted for review.

1.3.2.2 Other Loads

The door mullions where indicated must be of adequate strength to transmit the forces from design wind load, in addition to the other loads resulting from door operations or the door's action as a tributary element, with no detrimental effect on the operation of the door. The door manufacturer must submit the loads imposed upon the building structure by the vertical lift fabric door and its components.

1.3.3 Door Speed

Door must open fully at a speed of 152 mm 6 inches per second minimum under all design conditions. The door mullion when required must rotate with a cable retraction speed of 152 mm 6 inches per second minimum.

1.3.4 Door Weight

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NOTE: Careful coordination with the structural roof designer is required to ensure proper support of the vertical lift door system.

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The door manufacturer must provide load diagrams of the door in the closed and open positions. Details must also be provided showing clearance and attachment requirements for coordination with the structural steel and

miscellaneous steel shop drawings.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer's Qualifications

Use a vertical lift fabric door product from a manufacturer who is regularly engaged in the design, fabrication, erection, and service of vertical lift fabric doors of type and size required for this project. The manufacturer must have at least 5 years of similar vertical lift fabric 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) must be supervised by a manufacturer's representative and must be in accordance with approved shop drawings. Installers must be skilled and experienced in the erection of vertical lift fabric 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 must provide a three-year warranty for all mechanical and electrical components against defects in material and workmanship beginning on the date of Project Acceptance. The warranty for fabric must be ten years against defect in material.

1.4.3.1 Maintenance and Repair Action Plan

The door manufacturer must provide an Emergency and Routine Preventative Maintenance Plan. In addition to Data Package SD-10 "Operation and Maintenance Data", provide a list of phone numbers and personnel contacts. Also provide a list of suggested spare parts materials and tools to be purchased by the Contracting Officer. Submit vertical lift fabric door manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4.4 Delivery, Storage and Handling

The door manufacturer must provide shipment of all materials required for door installation in protective packaging. Protect door and accessories from damage during delivery, storage, and handling. Mark all packaging clearly with manufacturer's brand name, door model and job site location. Store in dry location with adequate ventilation, and free from dust and

water. Storage must permit easy access for inspection and handling. Remove damaged items that cannot be restored to like new condition or provide new items.

1.5 WELDING PROCEDURES AND QUALIFICATIONS

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

Comply with applicable provisions of AWS D1.1/D1.1M for Steel.

Comply with applicable provisions of AWS D1.2/D1.2M for Aluminum.

PART 2 PRODUCTS

2.1 MATERIALS

Materials must be selected based on durability, low maintenance, weather resistance and strength (permanent deformation from loading not allowed). Doors must comply with ASTM E84 for limited combustible construction.

2.1.1 Steel Plate and Bars

ASTM A36/A36M

2.1.2 Steel Sheet

ASTM A653/A653M

2.1.3 Steel Shapes

ASTM A992/A992M

2.1.4 Aluminum Extrusions

ASTM B221, Alloy 6063-T6, Alloy 6005-T5 or 6000 Series Aluminum

2.1.5 Aluminum Sheets and Strips

ASTM B209, alloy and temper best suited for the purpose.

2.1.6 Aluminum Welding Rods and Bare Electrodes

AWS A5.10/A5.10M.

2.1.7 Door Fabric

The fabric material must be a one piece heavy-duty vinyl coated polyester fabric weighing not less than 644 grams/square meter 19 oz/square yard, capable of carrying 4.46 kg/mm 250 lb/in per panel. Fabric must be impervious and resistant to solvents, fuel, lubricants and other similar fluids commonly found in aircraft maintenance hangars. It must be UV stabilized, self-extinguishing (0-75 flame spread), and suitable to withstand temperatures between plus 70 to minus 35 degrees C plus 158 to minus 31 degrees F in compliance with ASTM D2136. [Use a translucent material in approximately the top 3 m 10 feet of the door to allow day-lighting of the hangar high bay area. The translucent material must

also meet the same requirements and loadings as the standard door fabric.] Fabric color must be as selected by the Government from the manufacturer's standard colors. The door fabric must be pulled tight between the intermediate beams when the door is fully closed and the wind locks engaged. The fabric must have been tested to meet the criteria of ASTM E84-94 (flame spread - Class A interior wall and ceiling finish) and ASTM D2136 (cold cracking, brittleness and temperature).

2.1.8 Steel Cable and Wire Rope

ASTM A1023/A1023M.

2.2 DOORS

Doors must consist of hoist up fabric doors with intermediate aluminum beams or trusses. Fabric must be gathered above the head of the opening. Maximum wind load deflection of steel structural members of the door must not exceed the member length divided by 120. Maximum wind load deflection of extruded aluminum members of the door must not exceed the member length divided by 30.

2.2.1 Fabric Door Panels

The fabric must be attached to both sides of the intermediate beams, top beam, and bottom beam with self-tapping screws through corrosion resistant anodized or coated aluminum batten strips. Provide batten strip covers of PVC material to snap over the aluminum batten strips and be full width of the door fabric. Coated aluminum batten strips and PVC batten strip covers must be selected from the manufacturer's standard colors, which must offer a variety of options including colors to match the Standard Door Fabric color.

2.2.2 Door Beams

The intermediate beams must be corrosion resistant, extruded aluminum and have a suitable depth dependent on the door width and the wind load requirements. They must be spaced 890 to 1905 mm 35 to 75 inches apart, dependent upon the wind load. At each end of the beams there must be a guide block of self-lubricating material or rollers that run along the guides. Built-up members meeting these requirements are acceptable. The intermediate door beams and guide block or rollers must be designed to carry the full design wind load without failure and being pulled from the door guides. The guide block or roller design must not put the intermediate beam into tension which would cause pulling forces on door jambs. Guide block material must be nylon, polyoxymethylene (POM), or Ultra High Molecular Weight (UHMW) polyethylene. Rollers must be galvanized steel with maintenance free, lifetime sealed ball-bearings in case-hardened steel races.

2.2.3 Door Guides

The vertical guides must be an integral part of the door, made of extruded aluminum with a suitable depth and width dependent on the size of the intermediate beams and wind load requirements. The guides must be designed to provide weather sealing on the inside and outside faces. There must also be a space inside the guides for the nylon belt, polyester belt, or steel cable of the drive unit and safety arresters. The installer must provide jamb anchorage of size and type required for attachment of the guide rails as shown on the approved shop drawings. The

jamb anchorage and door guides must be designed to carry the full design wind load without failure and without permanent deformation.

2.3 ELECTRIC OPERATORS

2.3.1 Drive Units

Each door leaf must have a single or dual motor drive system with horsepower sized as appropriate for the weight of the door leaf. The gear motor must be equipped with a drum on which the nylon belt, polyester belt, or steel cables are wound. If a single motor drive is used, the belts and cables must be wound on the same drum. Cables must be wound on a grooved drum. The belts and cables must be attached to the bottom beam via the safety arresters. A hand crank device or other manual means must be provided on the motor for manual operation of the door in the event of a power failure. The gear motor must be removable without disturbing limit switch adjustment. The drive units will be coordinated with the location of aircraft such that the drive units are accessible while aircraft are in the hangar.

2.3.2 Belt/Cable System

A maximum of two belts/cables per door, running inside the door guides, must be used to transmit motive force to the door unit. Similarly, the quantity of sheaves used to guide the belts/cables must be minimized to reduce maintenance requirements and spare parts inventories. Belts/cables must be installed free of any kinks and the system design and sheave diameter must be such to prevent the occurrence of any kinks and abnormal stress in the operating belts/cables. Where belts/cables pass through openings of the building structure, the openings must be constructed so as to prevent abrasion, wear, or damage to the belts and cables. Sheave units must be provided in accessible locations that allow inspection and preventive maintenance. Sheaves must not be located in enclosed locations, which are not readily accessible for visual inspection.

2.3.3 Safety Arresters

Each door leaf must be supplied with two safety arresters that automatically activate and support the door in case the door lifting system fails similar to a belt or cable breaking. A "Safety Arrestor Operation Test" must be performed on each set of safety arresters by an independent testing source to withstand at least 110 percent of the maximum door leaf weight.

The "Safety Arrestor Operation Test" must be deemed successful when it contains at least the minimum following criteria:

a. Test door weight must be at least 110 percent of the specific project's door weight.

b. Test must simulate the door lifting system abruptly disengaging similar to a belt or cable breaking.

c. The Safety Arresters must automatically engage.

d. The test door weight must be brought to rest after an initial downward movement (or drop) of not more than 300 mm 12 inches and held firmly in this position.

e. Damage from activation of the Safety Arrestors must be limited to localized replaceable components and not cause a system failure which would require repair or replacement of the entire VLFD or the structural door jambs.

f. Independent testing source must submit documentation of successful " Safety Arrester Operation Test".

The moveable mullions, when provided, must be provided with a lifting motor that includes a backup arresting system or secondary brake system to prevent the mullion form falling in case of motor or primary brake failure.

2.3.4 Slack Belt/Cable Breaker

A safety device must be used on all door leaf belts/cables that will send a slack belt/cable condition and cut power to the appropriate drive unit to prevent an unsafe condition.

2.3.5 Motors

****

NOTE: Select the standard to which the motor will be rated. If IEC motors are utilized, the door electrical motors must comply with IEC standard IEC 60034-1, IEC 60034-5, IEC 60034-6 and IEC 60034-14. If NEMA motors are utilized, the door electrical motors must comply with NEMA MG-1. Coordinate with the local authority and regulations and standards at the location of the construction to determine which standard is applicable for the project.

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[NEMA MG 1][or][IEC 60034-1, IEC 60034-5, IEC 60034-6, IEC 60034-14], high-starting torque, reversible type with sufficient horsepower and torque output to move the door in either direction from any position. Motor must produce a door travel speed of not less than 150 mm 6 inches per second without exceeding the rated capacity. Motors must operate on voltage of the characteristics indicated at not more than 1800 rpm. Motor enclosures must be drip-proof type or NEMA totally-enclosed, fan-cooled (TEFC) type. A hand crank must be supplied which fits the motor for manual operation of the door in the event of a power failure. Install motors in approved locations. Motors must have a minimum service factor of 1.2 at continuous duty under maximum full load. The design of the door motor and door drive gear box must each have a safety factor of 2.5. Motors must be provided in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and requirement listed above.

2.3.6 Controls

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NOTE: Select the standard to which controller will be rated. If IEC controls are utilized, the door electrical controls must comply with IEC standards IEC 60204-1, IEC 60269-1, IEC 60269-2, IEC 60364-1, IEC 60364-5, IEC 60947-1, IEC 60947-2, IEC 60947-3, and IEC 60947-4-1. If NEMA controls are utilized, the door electrical controls must comply with NEMA AB-1, NEMA ICS-2, NEMA ICS-5, and NEMA KS-1. The door electrical controls must comply with NEMA

ICS-1, NEMA ICS-6, NFPA-70, NFPA-79, UL 98, UL 248-1, UL 248-12, UL 489, UL 508 and UL 1449. Coordinate with the local authority and regulations and standards at the location of the construction to determine which stands is applicable for the project.
****

Control equipment must conform to [NEMA ICS 2][or][IEC]. Control enclosures must be NEMA ICS 6, Type 12 or Type 4X. [The door electrical controls must comply with IEC standards IEC 60204-1, IEC 60269-1, IEC 60269-2, IEC 60364-1, IEC 60364-5, IEC 60947-1, IEC 60947-2, IEC 60947-3, and IEC 60947-4-1.][The door electrical controls must comply with NEMA AB 1, NEMA ICS 2, NEMA ICS 5, and NEMA KS 1. The door electrical controls must comply with NEMA ICS 1, NEMA ICS 6, NFPA 70, NFPA 79, UL 98, UL 248-1, UL 248-12, UL 489, UL 508, and UL 1449.] The door control components must all be UL listed.

Each Door Module must be provided with the following operators:

Master Control Panel (NEMA Type 4X or NEMA Type 12 enclosure)

a. Remote Push Button Station - at opposite end of hangar door (NEMA Type 4X enclosure).

b. Emergency Stop Buttons located outside at the end of each hangar bay (NEMA Type 4X enclosure).

c. "Open" operator located on the exterior of each bay door keyed for use by Fire Department personnel to allow entry in the event of an emergency (NEMA Type 4X enclosure).

The door supplier must provide all conduit and control wiring between master, slave, emergency stop controls, proximity switches, limit switches, and each door motor drive unit. Power and controls wiring and conduit must be provided in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.3.6.1 Control Panel Enclosures

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NOTE: Relay logic must be the default style of control. Programmable logic controller may be used if it is available from the manufacturer.
****

Control panel enclosures must be NEMA ICS 6, Type 12 or Type 4X. Each control panel must have an integral main power disconnect switch that is mechanically interlocked with the control panel door. Provide factory wired field wiring terminal strip in each control panel and instantaneous three-phase thermal overload relays. Provide each control panel enclosure including an internal motor starter or VFD with adequate integral ventilation (air conditioning if required) for operation in a49 degree C 120 degree F ambient environment. Provide [NEMA][or][IEC] rated control relays. Provide main control panel with [relay logic][programmable logic controller].

Provide a three phase UL 1449 listed surge protection device (SPD) for the incoming power to each door control panel. Provide a UL 1449 listed surge suppression device (SPD) for each control circuit (limit switch, proximity

switch, motor, brake, solenoid, indicating light, and pushbutton) that is routed external from each door main control panel.

The control panel must contain devices to control the logic and sequence of door and mullion operation to ensure safe operation. The control panel must also contain interlocks to preclude personnel injury, including an interlock between the power supply system and use of the hand crank for manual operation of the door. Constant-pressure type, fully guarded, illuminated push buttons must be provided on the control panel for both up and down operations. Mushroom type emergency stop button must be provided on each control panel. [Touch screen user interfaces will be used on multiple leaf hangar doors. Desired door or mullion motion will be selected via the touch screen. Door motion will be initiated via fully guarded push buttons.]

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NOTE: If a permanent generator is provided for the door, acquire approval from the applicable government agency. The addition of a generator may impact existing air pollution permits. Coordinate with the local authority to add a generator to the project. Coordinate the type of connection with other electrical specifications. Provide the details of the connection in the appropriate electrical section.

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Back-up power hook up must be provided at the control panel to connect to [a building backup power generator with automatic transfer switch] [a portable generator provided by the Base via a pin and sleeve female receptacle (coordinate with Base) and manual transfer switch provided on the main control panel].

2.3.7 Limit Switches

Provide limit switches or proximity switches to automatically stop doors [and mullions] at the fully open and fully closed positions. Limit switches or proximity switch positions must be readily adjustable. Limit switches or proximity switches for the wind lock must be provided with indicator lights installed on the control panel for each door leaf. The indicator must notify the door operator that the wind locks are engaged for all door leaves.

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NOTE: Include paragraph below when retractable mullion and floor strike are provided. Refer to the Section entitled, "Mullion Pit and Cover where Indicated".

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[Provide each retractable mullion pin with a limit switch or proximity switch interlock that proves that the mullion pin (whether electric or manual) is fully extended and locked before the door can be moved. If the limit switch or proximity switch is located below 0.46 meters 18 inches above the hangar floor, it must be either rated Class I Division 2 explosion-proof or the circuit must be intrinsically safe rated for a Class I Division 2 hazardous location.

] The door installer must demonstrate the operability of all limit switches

prior to Government occupancy.

2.3.8 Door Control Alarms

Provide an audible alarm device on each door main control panel (minimum 100 dbA) that sounds 10 seconds before the door moves and continues to sound when the door is moving. Coordinate this audible signal such that it is clearly different from all of the other audible signals utilized in the hangar bay.

Provide a visual alarm device above each door main control panel (rotating beacon with 100 watt halogen lamp) that operates 10 seconds before the door moves and continues to operate when the door is moving. Coordinate the color of this visual signal such that it is clearly a different color than all of the other visual signals utilized in the hangar bay.

2.3.9 Safety Device

Provide an intrinsically safe (suitable for a Class I Division 2 hazardous location) electric safety edge on the bottom of the edge of each door, continuous over the full length of the door. The safety edge must be located inside of a rubber cushioned bottom weather sealing edge (or boot) with sufficient vertical height (factoring in the time and distance that it takes to stop a closing door) that must prevent collision damage along the bottom edge of the door. The safety edge must be active when the door is closing, except it must be automatically de-activated the last (door length in metric inches/240) to allow for the L/240 deflection of the bottom beam which would prevent the door from stopping when only the middle of the door bottom beam (sagging with deflection) strikes the hangar floor before the ends of the door bottom beam reach the hangar floor, thus allowing the door to completely close along its entire length.

2.3.10 Control Transformers

Provide fused transformers inside of each Master Control Panel as necessary to reduce the voltage on the control circuits to 120 volts or less.

2.3.11 Electrical Components

NFPA 70. The door manufacturer must provide automatic control and safety devices, including failsafe battery powered wireless limit switches or hard-wired limit switches for mandoor interlocks. Cable reel type take-up devices must not be allowed. Control wiring must be in accordance with NFPA 70. The door supplier must provide conduit, wiring, and mounting of controls in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

****

NOTE: Include paragraph below only when a programmable logic controller is specified as an optional controls interface. The user interface with diagnostics must be an additional option and must not replace the other controls options.

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[2.3.12 User Interface with Diagnostics

The door manufacturer must supply a human machine interface (HMI) on the face of the Main Control Panel for multiple doors. The function of the

diagnostic panel is to provide information on the status of electrical components in the door system. The HMI must consist of a large (200-250 mm 8-10 inch diagonal measure) touch screen including a graphical representation of the door system to facility ease of use. The HMI must provide current door status including windlocks when applicable. A self diagnostic system must be included to provide detailed status information of a malfunction and provide guided trouble shooting and diagnostic features. The HMI must also provide a log for malfunctions and system alarms as well as provide detailed service monitoring and service history. Operation and configuration of the system must be controlled by multi-level password access to limit access to the system to qualified and authorized users. The HMI must include functionality for remote access to the system, by the manufacturer via both internet and cellular modem, to review malfunction logs, update settings, or assist in troubleshooting, should the user choose to allow such access.

]2.4 HEADER BOX

Header boxes must be constructed of carbon steel and finished per the Section entitled, "Finishes".

2.5 BOTTOM BEAM

The bottom beam must be constructed of carbon steel and finished per the Section entitled, "Finishes". The bottom beam must be provided with a suitable width and depth to carry the load of the intermediate beams when the door is open, and to ensure full closing and a tight floor seal in heavy winds. A heavy-duty bottom rubber seal must be provided to form a tight seal with the floor. The bottom edge safety device must be integral with the bottom seal.

2.6 WIND LOCK

Each door leaf must have wind locks at each jamb, which activate and lock the bottom beam into place when the door reaches its closed position. This locking action must act to maintain a tight floor seal and intermediate beam stability under design wind conditions. A limit switch or a proximity switch, with indicator must be provided to notify the door operator that all wind locks are engaged properly. Switches located below 45.7 cm 18 inches AFF must be compliant with NFPA 70, Class I, Division 2 hazardous environment.

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NOTE: The mullion pick up point of 3 meters 10 feet above finished floor is appropriate for mullions taller than 7.6 meters 25 feet. For mullions shorter than 7.6 meters 25 feet the pickup point can reasonably be lowered to 2.4 meters 8 feet above finished floor. The height of the pickup point affects the winch size required to pick it up and the stability of the mullion during movement. The lower pick up point creates a hazard for the user when the VLFD is open and the mullion is down.

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2.7 SWING-UP MULLION WHERE INDICATED

The swing-up mullions must be designed to swing up under the door leaf in the raised position. They must be constructed of carbon steel and

finished per the Section entitled, "Finishes". The mullion hinge pivot must be of a maintenance-free bearing design. The swing-up mullion must be raised and lowered by a wire rope hoist with a secondary back-up wire rope arresting system. If the secondary back-up wire rope arresting system is fully integrated into the hoist unit, it must be produced by one manufacturer. Wire rope hoist and secondary system must connect to mullion a minimum of 3.05 m 10 feet above finish floor. Refer to the Section entitled, "Electrical Operation" for controls and interlocks of mullion and door panels.

****
NOTE: Wheel loads shown are minimums. Designer to coordinate wheel loads with the project criteria.
****

2.7.1 Mullion Pit and Cover where Indicated

A mullion pit frame, guide plate, and cover(s), manufactured of aluminum or steel, must be provided for each mullion. Hinged cover plates, must be attached to the mullion pit frame. Mullion pit covers must be designed to support a 156 kN 35,000 pounds force single wheel load with a tire pressure of 1379 kPa 200 psi and contact area 0.1 square meters 1.2 sq ft.

2.7.2 Retractable Mullion Pin and Floor Strike when Utilized

Provide retractable mullion pin with a heavy duty, reversing electric linear actuator. Mullion pin and strike must be designed to resist all mullion design loads and accommodate all vertical movement of the mullion. Floor strike must have hinged cover, funnel shaped at the top, manufactured of aluminum or steel, and must accommodate mullion pin size and pin throw, and must be designed to support a155.7 kN 35,000 pounds force single wheel load with a tire pressure of 1379 kPa 200 psi and contact area 0.1 square meters 1.2 sq ft. Refer to the Section entitled, "Limit Switches" for information on mullion pin and floor strike limit switches.

2.8 PERSONNEL DOOR

[Personnel doors are not required in Hangar doors.
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NOTE: If photoluminescent exit sign is selected the designer must provide a night light such that the photoluminescent sign is continuously lit. In the event of a power outage the photoluminescent fixture must have enough storage energy.
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[Hangar door manufacturer must provide exit doors in hangar doors as indicated and required by NFPA 101. Personnel doors must be insulated steel or aluminum doors and as specified in Section [08 11 13 STEEL DOORS AND FRAMES][Section 08 11 16 ALUMINUM DOORS AND FRAMES]. Door must come complete with all hardware including, hinges, lockset, stop, weatherstripping, [illuminated][photoluminescent][reflective] emergency exit sign, and interlock.

]2.9 OPERATION

2.9.1 Door Operation

The vertical lift fabric door must guide up and down in the weather sealed vertical guides attached to the structure. The door must operate by lifting the bottom beam upwards, thereby stacking the intermediate beams one on top of the other, with the fabric panel folding in pleats. The fabric panel must go over the top beam, covering both sides of the door, and must be attached to the intermediate beams by screws and batten strips. When the door is fully closed, the intermediate beams must hang between the two fabric door panels thus pulling the fabric tight. The tension created in the fabric panels must stabilize the intermediate beams. The safety arresters must be attached to each end of the bottom beam and must travel in the vertical guide tracks. The safety arresters must immediately stop the downward movement of the door in case of belt/cable failure.

2.9.2 Electrical Operation

Provide the main control panel with control logic such that when the [integral female pin and sleeve emergency power receptacle is inserted and the integral manual transfer switch associated with the pin and sleeve receptacle is engaged][remote building automatic transfer switch "dry" auxiliary contact with the stationary emergency generator is closed in the "emergency" position] the control panel will automatically limit only one door lift motor or one mullion lift motor to operate at a time.

When the door is completely opened it must stop on the primary top limit switch. In case of over travel, a secondary limit switch must stop the door to prevent damage. The drive unit must be stopped by the slack belt/cable breakers when the door is closed. The slack breakers must also stop the door in case of belt/cable rupture or if an obstruction should prevent the door from being closed. Weight or springs must activate the slack breakers. The control panel station(s) must be of the illuminated pushbutton type or touchscreen.

Door operation must be controlled by three buttons marked "OPEN", "CLOSE", and "STOP". The "OPEN" and "STOP" buttons must require only momentary pressure to operate. The "CLOSE" button must require constant pressure to maintain the closing motion of the door. When the door is in motion and the "STOP" button is pressed or the "CLOSE" button is released, the door must stop instantly and remain in the stop position; from the stop position, the door must be operated in either direction by the "OPEN" or "CLOSE" buttons. Removing the pressure from the "CLOSE" button must stop the motor drive and set the brake.

Two buttons marked "Horizontal Position and Vertical Position" must control the mullion operation. Both buttons must be controlled by constant pressure to open and to close. Removing the pressure from either button must stop the motor drive and set the brake. The electrical control panel must provide an interlock function to coordinate door leaf and mullion operation.

Pushbuttons must be illuminated by LEDs and utilize simple flashing/solid illumination schemes to inform the operator of door status (fully open, closed, in motion, etc.). In lieu of illuminated pushbuttons, a large touchscreen display must be provided to select desired door leaf/mullion to operate and inform user of current door status. Pushbuttons must be

full-guarded to prevent accidental operation.

****

NOTE: Include paragraph below only when a programmable logic controller is specified as an optional controls interface. The user interface with diagnostics must be an additional option and must not replace the other controls options.

****

[Multipart doors must utilize a human machine interface display (HMI) for door leaf/mullion operation. Upon selection, door operation must be controlled by three buttons marked UP, DOWN, and STOP. The UP and STOP buttons must operate as indicated in the door operation controls section above.

When operating a mullion, controls must operate as described in the mullion operation controls above.

The main control panel must be equipped with backup method of controlling the door system should an HMI failure occur.

]2.10 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:

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.

Where possible also allow hot-dip galvanizing so the manufacturer may choose the best/most cost effective coating option. Hot-dip galvanizing may not always be appropriate as the process can warp long structural components or assemblies.

Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES is a complicated spec with significant content based on coating exterior tanks, and recoating of old steel. Since coatings related to vertical lift fabric doors will be shop coating of new steel, the only field painting should be touching up damage to the coating occurring during shipping and installation and coating of accessories such as bolts and brackets. We have therefore included a statement relieving the door contractor from most of the complicated submittals associated with large field coating projects.

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2.10.1 Ferrous Metal

Ferrous metal surfaces must be cleaned, prepared and shop-finished in accordance with Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES [or hot-dip galvanized in accordance with ASTM A653/A653M,

coating designation Z275, for steel sheets, and ASTM A123/A123M for assembled steel products]. Follow coating system manufacturer's written instructions. All coating of ferrous metal must be shop-finished and the only necessary field painting should be touch-up painting and coating of any unfinished accessories such as bolts and brackets. The following submittals if required by Section 09 97 13.27 are not required for shop-finished vertical lift fabric doors: Work Plans, Coating Inspection Reports, Test Reports, and Qualifications for Certified Industrial Hygienists, Protective Coating Specialists, Blasters, Painters and Inspectors.

2.10.2 Aluminum

Batten strip surfaces must receive [a clear anodized finish, AA-M12-C22-A41 per Aluminum Association Designation System, AA DAF45, in accordance with NAAMM AMP 500 complying with AAMA 611][a high performance organic coating finish, AA-C12C42R1 per Aluminum Association Designation System, AA DAF45, fluoropolymer 2-coat coating system in accordance with NAAMM AMP 500 complying with AAMA 2604].

2.11 SIGNAGE

Provide a placard sign immediately adjacent to the control panel indicating the following:

Notice:

Vertical lift fabric doors must be closed and not operated when wind speeds above[96.6 km/hr 60 mph][_____] are expected.

Vertical lift fabric doors must be transferred to back-up power for operation when commercial power is not available.

PART 3 EXECUTION

3.1 PROTECTIVE COATINGS

3.1.1 Cleaning

After fabrication, clean all metal surfaces thoroughly of all mill scale, rust, oil, grease and other foreign substances. Apply rust-preventive primer to all steel parts immediately after cleaning.

3.1.2 Shop Painting

After cleaning, coat with primer all steel surfaces other than machine-finished parts. Keep paint off finished bearing surfaces. Before assembly, prime surfaces that will be inaccessible after assembly. Handle painted materials with care to avoid scraping and breaking the protective film. Ferrous metal surfaces that will be exposed after fabrication must be shop coated and touch-up painted in the field by the vertical lift fabric door installer per the Section entitled, "Finishes".

3.1.3 Metal Protection

Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact masonry or concrete, protect against corrosion by painting contact

surfaces with bituminous coating.

3.2 ERECTION

Coordinate the erection of the doors with the work of other trades. Ensure that all steel support, bracing and framing members are furnished and accurately installed for the proper installation of the door hardware.

3.2.1 Assembly

Assemble and install the doors and accessories in accordance with the manufacturer's recommendations and installation manual. Secure guides to the walls plum, level, and in-line. Anchor guides at spacing indicated on the manufacturer's installation drawings. Provide additional supports as necessary for attachment of guides, brackets, doors, and operation mechanisms. After erection is complete and before touch-up field painting is applied, thoroughly clean all abraded surfaces, field welds, and field bolts; coat per the Section entitled, "Finishes".

3.2.2 Cleaning

Clean both the interior and exterior of doors after erection.

3.2.3 Control Panel Installation

Locate each door main control panel indoors, adjacent to the door opening, and with an unobstructed line of sight for the entire door opening. All conduit entries must be into the bottom of the control panel. Contractor must mount master control panel and provide three phase power to the control panel.

3.3 ACCEPTANCE TESTING PROCEDURE AND REPORT

The door manufacturer must submit an Acceptance Testing Procedure for approval. After Government approval, the vertical lift fabric door manufacturer must perform the testing and submit a report of the results. The Acceptance testing must include all testing of the door and components performed by the door manufacturer and suppliers. The Acceptance testing will also include the following subparagraphs.

3.3.1 General

Upon completion of installation, including work by other trades, lubricate, adjust, and test doors to verify operation on accordance with manufacturer's product data. Manufacturer's authorized representative must make final adjustment. Adjust and re-test the doors until the entire installation is fully operational and acceptable. Acceptance testing must consist of operating each door and mullion (when included) open and closed (one cycle) ten times successfully and consecutively within a nine-hour time interval in accordance with manufacturer's recommended time interval between open/close cycles. Provide Contracting Officer's Representative an acceptance testing report of completed tests.

3.3.2 Safety Arresters

Perform a non-destructive demonstration of the safety arrester function by engaging the installed safety arresters on the guiderails at a height of 1 m 3 feet above closed position. Demonstration must be performed on all doors installed on Project in the presence of the COR.

3.3.3 Personnel Training

The door manufacturer must provide an 8-hour on-site training session for the door operating personnel and maintenance department. The training must outline door operation, troubleshooting and repair guidelines.

3.4 EXTRA MATERIALS

A door fabric patch kit must be supplied with approximately 4.2 square meters 45 square feet of fabric for each hangar door and all other materials required for door panel repair. Patch kit fabric color and associated materials must match door fabric color provided.

3.5 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 --