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USACE / NAVFAC / AFCEC / NASA | UFGS-08 34 16.20 (August 2021)
Change 1 - 11/21

Preparing Activity: NAVFAC | Superseding
UFGS-08 34 16.20 (May 2014)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 34 16.20

VERTICAL LIFT FABRIC DOORS

08/21, CHG 1: 11/21

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
1.3.1.2 Aluminum Door Components
1.3.1.3 Door Operational Performance
1.3.2 Loads
1.3.2.1 Wind Loads
1.3.2.2 Other Loads
1.3.3 Door Speed
1.3.4 Door Weight
1.3.5 Cybersecurity
1.4 QUALITY ASSURANCE
1.4.1 Manufacturer's Qualifications
1.4.2 Installer's Qualifications
1.4.3 Warranty
1.4.3.1 Maintenance and Repair Action Plan
1.4.4 Delivery, Storage and Handling
1.5 WELDING PROCEDURES AND QUALIFICATIONS

PART 2 PRODUCTS

2.1 MATERIALS
2.1.1 Steel Plate and Bars
2.1.2 Steel Sheet
2.1.3 Steel Shapes
2.1.4 Aluminum Extrusions
2.1.5 Aluminum Sheets and Strips
2.1.6 Aluminum Welding Rods and Bare Electrodes
2.1.7 Door Fabric
2.1.8 Wire Rope

2.2 DOORS
2.2.1 Fabric Door Leaves
2.2.2 Intermediate Door Beams
2.2.3 Door Guides
2.3 ELECTRIC OPERATORS
2.3.1 Drive Units
2.3.2 Belt/Wire Rope System
2.3.3 Door Drop Prevention
2.3.3.1 Door Leaf Safety Arresters
2.3.3.2 Door Leaf Safety Arrester Alternative
2.3.3.3 Swing-Up Door Mullion Safety Arrester
2.3.4 Slack Belt/Wire Rope Breaker
2.3.5 Motors
2.3.6 Controls
2.3.6.1 Control Panel Enclosures
2.3.7 Limit Switches
2.3.8 Door Control Alarms
2.3.9 Safety Device
2.3.10 Control Transformers
2.3.11 Electrical Components
2.3.12 User Interface with Diagnostics
2.4 HEADER BOX
2.5 BOTTOM BEAM
2.6 WIND LOCK
2.7 SWING-UP MULLION WHERE INDICATED
2.7.1 Mullion Pit and Cover where Indicated
2.7.2 Retractable Mullion Pin and Floor Strike
2.8 PERSONNEL DOOR
2.9 OPERATION
2.9.1 Door Operation
2.9.2 Electrical Operation
2.9.3 Backup Door Operation
2.10 FINISHES
2.10.1 Ferrous Metal
2.10.2 Aluminum
2.11 SIGNAGE

PART 3 EXECUTION

3.1 PROTECTIVE COATINGS
3.1.1 Cleaning
3.1.2 Shop Painting
3.1.3 Metal Protection
3.2 WELDS
3.2.1 Visual Inspection
3.2.2 Nondestructive Testing
3.3 ERECTION
3.3.1 Assembly
3.3.2 Cleaning
3.3.3 Control Panel Installation
3.4 ELECTRICAL WORK
3.5 ACCEPTANCE TESTING PROCEDURE AND REPORT
3.5.1 General
3.5.2 Door Drop Prevention Demonstration
3.6 PERSONNEL TRAINING
3.7 EXTRA MATERIALS
3.8 INSPECTION AND ADJUSTMENT

-- End of Section Table of Contents --

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 08 34 16.20

VERTICAL LIFT FABRIC DOORS
08/21, CHG 1: 11/21

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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. For example, if providing a single door (leaf) remove requirements for mullions, mullion pits,and other applicable door elements.

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 door system 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 DoD "wind-borne debris regions" and do not meet the testing criteria of ASTM E1996/ASTM E1886 (Refer to UFC 3-310-01 Paragraph 2-4.6 for additional information).

Testing is underway by some manufacturers to find and develop vertical lift fabric door systems which meet these requirements.

When this specification is used for a fuel cell maintenance hangar, paint hangar, or corrosion control hangar the hazardous classification may impact electrical components of the vertical lift fabric door system - such as the electrical drive, limit switches, control panels, and other electrical devices. All electrical devices within the hazardous classification areas must be specified to be rated for the hazardous location where electrical equipment is installed.

To properly coordinate with this specification, the drawings must, at a minimum, indicate the following information:

1. **Size and arrangement of doors including, if applicable, clearances in accordance with UFC 4-211-01 Paragraph 2.3 MINIMUM AIRCRAFT MAINTENANCE BAY CLEARANCES.**
2. **Preferred location of mullions, mullion pits and mullion swing, as applicable.**
3. **Electrical and structural provisions and preferred locations 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(s).**
5. **Design wind velocity and appropriate design wind pressures based on the design wind velocity. See paragraph below entitled, WIND LOADS for more detailed requirements.**
6. **Anticipated, service level maximum vertical deflections (up and down) of the building structure from which the door system will be supported. Deflections should not include dead load - but should be indicative of the anticipated deflections that may be experienced during the life the door and building. Additionally, the structural engineer of record shall coordinate with manufacturers on supporting structure serviceability limitations and provide camber to anticipate deadloads including the weight of the door.**

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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 2605	(2020) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing 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 SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

AMERICAN WELDING SOCIETY (AWS)

AWS A5.10/A5.10M	(2021) Welding Consumables - Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum-Alloys - Classification
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum
AWS D1.8/D1.8M	(2016) Structural Welding Code—Seismic Supplement

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	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A992/A992M	(2022) Standard Specification for Structural Steel Shapes
ASTM A1023/A1023M	(2021) 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	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D751	(2006; R 2011) Coated Fabrics
ASTM D2136	(2002; R 2012) Coated Fabrics - Low-Temperature Bend Test
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60034-1	(2022) 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	(2021) Safety of Machinery – 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; Corr 1 2022) 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; Corr 1 2021) Low-Voltage Switchgear and Controlgear – Part 3: Switches, Disconnectors, Switch-Disconnectors and Fuse-Combination Units
IEC 60947-4-1	(2018; INT 1 2020; Corr 2 2021) 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	(2022) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2020) 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	(2021) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 79	(2015) Electrical Standard for Industrial Machinery
NFPA 220	(2024) Standard on Types of Building Construction
NFPA 409	(2022) Standard on Aircraft Hangars

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-889	(2021; Rev D) Galvanic Compatibility of Electrically Conductive Materials
UFC 1-200-01	(2022) DoD Building Code
UFC 3-301-01	(2023) Structural Engineering
UFC 4-010-06	(2016; with Change 1, 2017) Cybersecurity of Facility-Related Control Systems

UNDERWRITERS LABORATORIES (UL)

UL 98	(2016; Reprint Jan 2022) UL Standard for Safety Enclosed and Dead-Front Switches
UL 248-1	(2011) Low Voltage Fuses - Part 1: General Requirements
UL 248-12	(2011; Reprint Aug 2020) Low Voltage Fuses - Part 12: Class R Fuses
UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508	(2018; Reprint Jul 2021) UL Standard for Safety Industrial Control Equipment
UL 698A	(2018; Rev 2019) UL Standard for Safety Industrial Control Panels Relating to Hazardous (Classified) Locations

UL 1449 (2021; Reprint Dec 2022) 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 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.
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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 SUBMITTAL PROCEDURES:

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.

Door Design; G[, [_____]]

SD-03 Product Data

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

Electric Operator; G[, [_____]]

Motors; G[, [_____]]

Doors; G[, [_____]]

Controls; G[, [_____]]

Door Fabric; G[, [_____]]

Surge Protection Device (SPD); G[, [_____]]

SD-05 Design Data

Calculations; G[, [_____]]

Door Load Diagrams; G[, [_____]]

Door Compliance Matrix; G[, [_____]]

SD-06 Test Reports

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

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

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

Door Fabric Connection; G[, [_____]]

Weld Inspection Report; 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[, [_____]]

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 and without binding, interfering, or damaging the adjacent structure or itself. Provide a door with a minimum maintenance free operation for 3 years or 1,500 cycles, whichever occurs first, as counted by the door close limit switch. Construct the door with limited combustible construction materials in accordance with NFPA 220 and NFPA 409.

Include a Door Compliance Matrix along with your submittal which references each specification requirement and the corresponding document and page number where compliance may be verified by the reviewer.

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.

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. Demonstrate through detailing that the indicated superstructure's non-dead load, service level deflections are accommodated in both the downward and upward directions. Indicate finishes to be used.

1.3.1.1 Steel Door Components

The door manufacturer's registered professional engineer is responsible for designing all supporting, bracing and framing steel members associated with the door system for the specified loads in accordance with the requirements of AISC 325 and AISC 360. Comply with the AWS D1.1/D1.1M Standards for all steel welding. Refer to Section 05 12 00 STRUCTURAL STEEL for other requirements, including bolted connections.

1.3.1.2 Aluminum Door Components

The door manufacturer's registered professional engineer is responsible for designing all supporting, bracing and framing aluminum members associated with the door system for the specified loads in accordance with the requirements of the Aluminum Association (AA ADM). Comply with the AWS D1.2/D1.2M Standards for all aluminum welding.

1.3.1.3 Door Operational Performance

Provide a door which does not bind, catch or become adversely out of level during door operation. Door operation includes (1) fully opening then closing, (2) partially opening then closing, and (3) partially opening, then fully opening, and then closing. Partially opened doors may occur at any intermediate point and smooth operation of the door is required with smooth operation without binding.

1.3.2 Loads

Use the governing design loads for the design of the door system 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, UFC 3-301-01 and, if applicable, UFC 4-211-01, the Engineer of Record must indicate the appropriate design wind pressures for the design of the door system on the drawings. The simplified procedure/method must not be used to calculate the design wind pressures for the door system, only the analytical procedure is permitted. The structure of the building volume accessed by the vertical lift fabric door must be designed as a Partially Enclosed building in accordance with UFC 3-301-01 paragraph 2-4.6. The door system design pressure must be based on the specific project design criteria and on the design wind velocity for components and cladding based upon each structural element's associated tributary area. An example table of required design wind pressures is shown below and must be included in the drawings.

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.

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In the closed position, design the entire door system to withstand the

component and cladding wind pressures as indicated by the Engineer of Record for a Partially Enclosed building, based upon the indicated design wind velocity, geometry and other factors. Design all elements of the door's components and cladding to withstand both the highest positive and negative pressures based upon the actual tributary area from the wind, as indicated.

In addition, design the entire door system to be both fully open and fully operational for wind velocities up to 124 km/h 77 mph. Calculate the applicable component and cladding wind pressures, including importance factor, and utilize the controlling wind pressures or a positive and negative wind pressure of 0.718 kPa 15 psf on the surface of the door, whichever is greater. Design door mullions and jambs for the unbalanced positive or negative pressure on the surface of a closed adjacent door with the other adjacent door being open.

Submit complete calculations for all components sealed by the door manufacturer's registered professional engineer for review. Include calculations with analysis of the intermediate and bottom beams using the above applied wind conditions and door positions. Do not design intermediate or bottom beams to rely upon stabilization or bracing from the fabric when the door is not in the closed position. In both the open and closed position, design all intermediate beams for the maximum potential rotation permitted by manufacturer detailing such that applied wind loads are not assumed to act in only the strong axis.

1.3.2.2 Other Loads

Provide door mullions and jambs of adequate strength to transmit the forces from design wind loads, 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. Submit the vertical and horizontal loads imposed upon the building structure by the vertical lift fabric door system.

1.3.3 Door Speed

Provide for each door leaf to open fully with a minimum speed of 152 mm 6 inches per second under all design conditions. Provide door mullion(s), when required by the contract documents, to rotate with a minimum wire rope retraction speed of 152 mm 6 inches per second.

1.3.4 Door Weight

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

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Submit door load diagrams of the door in the closed and governing open position(s). Provide details showing clearance and attachment requirements for coordination with the structural steel, miscellaneous steel, slab/foundation, and demonstration that superstructure's unfactored deflections are accommodated by the design of the mullions, pits and door leaves.

1.3.5 Cybersecurity

Design all control systems (including systems separate from a utility monitoring and control system) in accordance with UFC 4-010-06 and as required by Section 25 05 11 [_____] CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS [_____]. Implement cybersecurity requirements to mitigate vulnerabilities to all facility-related control systems.

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. Submit written manufacturer 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

A manufacturer's representative, skilled and experienced in the erection of vertical lift fabric doors of the type specified herein, is required to supervise installation of the door system(s) in accordance with approved shop drawings. For each Installer, 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

Provide a three-year warranty for all mechanical and electrical components against defects in material and workmanship beginning on the date of Project Acceptance. Manufacturer is responsible for items requiring adjustment, repair or replacement for the three-year maintenance-free warranty period, or 1500 door cycles, whichever occurs first. Provide a ten year warranty for defects in the fabric material.

1.4.3.1 Maintenance and Repair Action Plan

Provide an Emergency and Routine Preventative Maintenance Plan. In Data Package SD-10 "Operation and Maintenance Data", include a list of phone numbers and personnel contactsand provide a list of suggested spare parts materials and tools to be purchased by the Contracting Officer. Include a list of annual visual safety inspections to be performed or contracted by the government and provide a door design which accommodates each of the visual inspection items with removable panels or viewing ports where inspection items are not directly viewable. A Preventative Maintenance

Plan which requires adjustment or maintenance intervals less than 3 years or 1,500 cycles is not permitted.

Submit vertical lift fabric door manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4.4 Delivery, Storage and Handling

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. If the qualification date of the welder or welding operator is more than 6 months old, the welding operator's qualification certificate must be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

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

Select materials based on durability, low maintenance, weather resistance and strength (permanent deformation from loading is not permitted). Comply with ASTM E84 for limited combustible construction for all door system materials.

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

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NOTE: Translucent fabric is not recommended in all geographies (i.e. extremely high UV index areas, such as the Middle East). Additionally, very high fabric tension forces may require heavier fabric (i.e. 800plus gram/square meter) which limits its intended purpose. Prior to including any of the below options for translucent panels, consult with a manufacturer.
****

Provide fabric material that is a heavy-duty, rip stop, 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. Provide fabric that is impervious and resistant to solvents, fuel, lubricants, and other similar fluids commonly found in aircraft maintenance hangars. Provide fabric that is ultraviolet (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 fabric material [in approximately the top 3 m 10 feet of the door] [as shown in the drawings] to allow daylighting of the hangar aircraft servicing area. Provide translucent fabric material that meets the same requirements and loadings as the standard door fabric.] Fabric color will be selected by the Government from the manufacturer's standard colors. Construct door system such that fabric is tight between the intermediate beams when the door is closed and the wind locks engaged. Test the fabric to meet the criteria of ASTM E84 (flame spread - Class A interior wall and ceiling finish), ASTM D2136 (cold cracking, brittleness and temperature), and ASTM D751 (tensile and tear strength). Provide a minimum 4:1 factor of safety on the fabric design while accounting for degradation due to UV and temperature effects.

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

2.1.8 Wire Rope

ASTM A1023/A1023M.

2.2 DOORS

Door system consists of individual hoist-up fabric door leaves with intermediate aluminum beams or trusses. Maximum wind load deflection of steel structural door members is not to exceed the member length divided by 120. Maximum wind load deflection of extruded aluminum door members is not to exceed the member length divided by 30. Design and install the door system to accommodate the anticipated downward deflection due to self weight of the door system after all the building dead load has been applied. Then provide a door system which accommodates the stated unfactored downward and upward deflections of the superstructure to which it is being attached.

2.2.1 Fabric Door Leaves

When one-piece fabric construction is utilized, loop fabric over the uppermost beam and attach the fabric to both flanges of the intermediate beams, top beam, and bottom beam with self-tapping screws through corrosion resistant anodized or coated aluminum batten strip. Provide independent, third party laboratory testing to demonstrate door fabric connection has a minimum 2:1 factor of safety above the required connection forces while accounting for fabric degradation due to UV and temperature effects.

Alternatively, when fabric panel construction is utilized, attach the fabric at all beams using a keder type connection. Provide independent, third party laboratory testing to demonstrate connections are stronger than the fabric.

2.2.2 Intermediate Door Beams

Provide corrosion resistant, extruded aluminum intermediate beams of a suitable depth dependent on the door width and the wind load requirements with a spacing not to exceed 1800 mm 6 feet. Provide, at each end of the beams, a guide block of self-lubricating material or rollers that run along the guides. Built-up members meeting these requirements are acceptable. Design the intermediate door beams and guide block or rollers to carry the full design wind load without failure and without being pulled from the door guides. Guide block or roller design cannot put the intermediate beam into tension under design wind load which would cause pulling forces on door jambs. Provide guide block material of nylon, polyoxymethylene (POM), or Ultra High Molecular Weight (UHMW) polyethylene. Provide rollers that are galvanized steel with maintenance free, lifetime sealed ball-bearings in case-hardened steel races. Midspan splices are prohibited in intermediate beams.

2.2.3 Door Guides

The vertical door guides are 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. Provide guide rails with a T-shaped center guide designed to prevent guide blocks from escaping the guides and designed to prevent placing the intermediate beam in tension under design winds loads (catenary effect). Design the guides to provide weather sealing on the inside and outside faces. Provide adequate space inside the guides, or within the door, for all required components such as the nylon belt, polyester belt, or wire rope of the drive unit, windlocks and safety arresters. Provide removable door guides with anchorage to the mullion and jambs, as applicable, of the size and type required to carry the full design wind load without failure and without permanent deformation. Removable door guides will be mechanically fastened to permit the guide rail to be readily removed with standard tools. Provide guide blocks or roller, inside the guides, sufficient to prevent scraping or damage to the guide rail during normal door operation.

2.3 ELECTRIC OPERATORS

2.3.1 Drive Units

Provide each door leaf with a motor drive system with horsepower sized as appropriate for the weight of the door leaf plus door friction to account for operational wind speeds and corresponding pressures. Equip the gear

motor with a drum on which the nylon belt, polyester belt, or wire ropes are wound, including required safety wraps and connections. For dead ends on wire ropes, provide a minimum of two unclamped dead wraps on the wire rope drum with the dead end anchored on the drum barrel by clamps or by inserting end fitting into reinforced pockets. For hoists using synthetic belts, provide a minimum of five dead wraps and belt anchorage to the drum.

If a single motor drive is used, wind the belts and wire ropes on the same drum. When using wire ropes, provide a grooved drum. Attach the belts and wire ropes to the bottom beam via the safety arresters. Provide a hand crank device or other manual means on the motor for manual operation of the door in the event of a power failure. Provide a gear motor that is removable without disturbing limit switch adjustment. Coordinate the drive units with the location of aircraft such that the drive units are accessible while aircraft are in the hangar.

Submit drive unit system horsepower, belt type, and locations. Safety arrestor type, test reports, and brake system details.

2.3.2 Belt/Wire Rope System

Properly select and utilize belts and/or wire ropes to transmit motive force to each door leaf. Install belts/wire ropes free of any kinks and design the system and sheave diameter to prevent the occurrence of any kinks, and abnormal stress in the operating belts/wire ropes. Where belts/wire ropes pass through openings of the building structure, construct the openings to prevent abrasion, wear, or damage to the belts/wire ropes. Design belts, wire ropes, and their connections to have a minimum 6:1 factor of safety, including impact loads.

Do not use belt systems where individual lifted door weight exceeds 2800 Kg 6,200 Lbs. Include edge wear indicators on belts and properly terminate at all connections. Provide fully stitched flat eye belt terminations which are permanent and do not require routine adjustment or maintenance.

Properly swage wire rope ends and include thimble loops to prevent wire rope abrasion at end connections. Provide wire rope end connections which are permanent and do not require routine adjustment or maintenance.

Minimize the quantity of motors, sheaves and drums used to guide the belts or wire ropes to reduce maintenance requirements. Provide sheave units in accessible locations that allow inspection and preventive maintenance. Do not locate motors, sheaves, and drums in enclosed locations, which are not readily accessible for visual inspection and maintenance.

2.3.3 Door Drop Prevention

2.3.3.1 Door Leaf Safety Arresters

Supply each door leaf with safety arresters at each jamb door guide that automatically activate and support the door in case the door lifting system fails similar to a belt or wire rope breaking. Attach safety arresters to each end of the bottom beam which travel in the vertical guide tracks and cannot escape from, or pull off of, the door's guide rails. Provide safety arresters that immediately engage to stop the downward movement of the door in case of belt/wire rope failure in accordance with the below test requirements.

Perform a "Safety Arrestor Operation Test" on each set of safety arresters

by a nationally recognized independent testing source to withstand at least 110 percent of the maximum door leaf weight.

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

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

b. Test by simulating the door lifting system abruptly disengaging, similar to a belt or wire rope breaking.

c. Verify the Safety Arresters automatically engage.

d. Verify door leaf is brought to rest after an initial downward movement (or drop) of not more than 300 mm 12 inches and that the door leaf is held firmly in this position.

e. Verify that damage from activation of the Safety Arrestors is limited to localized replaceable components, such as the guide rails or safety arrestors, and not a system failure which would require repair or replacement of any other portion of the door system or its structural support.

Submit independent testing source documentation of successful "Safety Arrester Operation Test".

2.3.3.2 Door Leaf Safety Arrester Alternative

Door leaf safety arresters may be omitted, if each door leaf is provided with four or more lifting belts/wire ropes and if is it demonstrated through analysis of the entire door system that the door leaf remains stable, without falling, with the loss of either end belt/wire rope, or any two intermediate belts/wire ropes. Additionally demonstrate, that other failure mechanisms inherent in the door system will not result in a falling door leaf.

[2.3.3.3 Swing-Up Door Mullion Safety Arrester

Provide swing-up door mullions with a lifting motor that includes a backup arresting system or secondary brake system to prevent the mullion from falling in case of motor, wire rope, or primary brake failure.

]2.3.4 Slack Belt/Wire Rope Breaker

Use a safety device on all belts and wire ropes that will send a slack belt/wire rope condition to the appropriate drive unit(s) and prevent unsafe operation or any other 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.
****

[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. Provide a motor to produce a door travel speed of not less than 150 mm 6 inches per second without exceeding the rated capacity. Provide motors that operate on the indicated voltage. Provide motor enclosures that are drip-proof type or NEMA totally enclosed. Supply a hand crank which fits the motor for manual operation of the door in the event of a power failure. Install motors in approved locations. Provide motors that have a minimum service factor of 1.2 at continuous duty under maximum full load. Provide motors in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and requirements listed above.

When two or more motors are used, provide mechanical linkage, electronic position monitoring and/or logic to eliminate the possibility that the door may bind, catch or become adversely out of level during door operation.

Submit motor characteristics including horsepower, service factor, safety factor, and standards compliance.

2.3.6 Controls

****
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, UL 1449 and UL 698A. Coordinate with the local authority and regulations and standards at the location of the construction to determine which stands is applicable for the project.

When presented with the choice of NEMA 4 or NEMA 4X in the below paragraphs, select NEMA 4X in corrosive environments and NEMA 4 in non-corrosive environments.
****

Provide control equipment in accordance with [NEMA ICS 2][or][IEC]. Provide control enclosures in accordance with NEMA ICS 6, Type 12 or Type 4X.[Provide door electrical controls in accordance 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.][Provide door electrical controls in accordance with NEMA AB 1, NEMA ICS 2, NEMA ICS 5, and NEMA KS 1. Provide door electrical controls in accordance with NEMA ICS 1, NEMA ICS 6, NFPA 70, NFPA 79, UL 98, UL 248-1, UL 248-12, UL 489, UL 508, UL 1449, and UL 698A.] Provide UL listed door control

components. Provide each Door Module with the following operators:

a. Main Control Panel (Station) [NEMA Type 4][NEMA Type 4X] enclosure.

b. Remote (Auxiliary) Control Panel (Station) at the opposite end of hangar door [NEMA Type 4][NEMA Type 4X] enclosure to match Main Control Panel.

[c. Provide emergency Stop Buttons located outside at the end of each hangar bay in a NEMA Type 4X enclosure.

] d. Provide "Open" operator on the exterior of each bay of doors, keyed for use by Fire Department personnel to allow entry in the event of an emergency, in a NEMA Type 4X enclosure.

Provide conduit and control wiring between Main, Auxiliary, emergency stop controls, proximity switches, limit switches, and each door motor drive unit. Provide power and controls wiring and conduit in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

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

2.3.6.1 Control Panel Enclosures

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NOTE: Relay logic must be the default style of control for single leaf doors. A Programmable logic controller is required to be used and paired with the User Interface with diagnostics by default for multi-leaf doors and is optional for single leaf doors.

****

Provide NEMA ICS 6, Type 12 or Type 4X control panel enclosures. Provide an integral main power disconnect switch that is mechanically interlocked with the control panel door at each control panel. 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 a 49 degree C 120 degree F ambient environment. Provide [NEMA][or][IEC] rated control relays. Provide main control panel with 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.

Submit data for each incoming [and][or] outgoing power feeder and each control circuit.

Provide devices to control the logic and sequence of door and mullion operation to ensure safe, smooth and dependable operation at each control panel. Provide 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. Provide constant-pressure type, fully

guarded, illuminated push buttons on the control panel for both up and down operations. Provide mushroom type emergency stop button on each control panel. Utilize individual user password protected touch screen interface to select desired door or mullion motion. Door motion will be initiated via fully guarded push buttons.

****

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.

****

Provide back-up power hook up 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. Provide limit switches or proximity switch positions that are readily adjustable. Provide limit switches or proximity switches for the wind lock with visual indication on the control panel for each door leaf. Provide visual indication to notify the door operator that the wind locks are engaged for all door leaves.

****

NOTE: Include paragraph below when the Government decides to include retractable mullion pins and floor strikes. Recommend discussing with potential manufacturers. Advantages include a significantly smaller mullion pit and covers. Disadvantages include additional cost, maintenance and potential operating issues/errors associated with each motor and limit switch along with design/construction complexities associated with the Class I Division 2 challenges. Refer also to paragraph MULLION PIT AND COVER WHERE INDICATED.

****

[Provide each retractable mullion pin with a limit switch or proximity switch interlock that proves that the electric mullion pin 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, either provide rated Class I Division 2 explosion-proof device or provide an intrinsically safe circuit rated for a Class I Division 2 hazardous location.

] 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 5 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 (LED beacon with 1600 lumens) that operates 5 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. Provide a safety edge 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) to prevent collision damage along the bottom edge of the door. Activate the safety edge when the door is closing and do not allow the safety edge to prevent the door from completely closing and properly sealing along its entire length.

2.3.10 Control Transformers

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

2.3.11 Electrical Components

NFPA 70. Provide automatic control and safety devices, including failsafe battery powered wireless limit switches or hard-wired limit switches electrified components[including personnel door interlocks]. Wire rope reel type take-up devices are not allowed. Provide control wiring in accordance with NFPA 70. Provide conduit, wiring, and mounting of controls in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

[2.3.12 User Interface with Diagnostics

****

NOTE: Include paragraph below only when a programmable logic controller is specified as an optional controls interface. The user interface with diagnostics is an additional option and does not replace the other controls options. Include Human Machine Interface paragraph below when specifying a multi-part (multi-leaf) door system. Do not include for single leaf door systems without confirming with the government and manufacturers as the cost typically outweighs the benefits (exceptions may include alert hangars).

****

Supply a human machine interface (HMI) on the face of the Main Control Panel and all Auxiliary Control Panels. The function of the diagnostic panel is to provide information on the status of electrical components in

the door system. Provide a large (250 mm 10 inch minimum diagonal measure) HMI touch screen to include a graphical representation of the entire door system to facilitate ease of use. Provide the HMI with current door status including windlocks. Include a self-diagnostic system to provide detailed status information of a malfunction and provide guided trouble shooting and diagnostic features. Provide a log for malfunctions and system alarms on the HMI as well as detailed service monitoring and service history. Control operation and configuration of the system is by unique, multi-level password access to limit access to the system to qualified and authorized users. Provide HMI with automatic screen lock after 60 seconds of inactivity. Include functionality on the HMI for remote access to the system, by the manufacturer via both Internet and cellular modem, to review malfunction logs, update programming/settings, or assist in troubleshooting, should the user choose to permit such access as permitted by cybersecurity restrictions.

]2.4 HEADER BOX

Construct the header boxes of carbon steel and finished in accordance with the paragraph FINISHES.

2.5 BOTTOM BEAM

Construct the bottom beam of carbon steel and finished in accordance with the paragraph FINISHES. Provide a bottom beam of a suitable width and depth to carry the load of the intermediate beams when the door is not closed, and to ensure full closing and a tight floor seal under full design wind speeds spanning between windlocks located at each jamb. Provide a heavy-duty bottom rubber seal to form a tight seal with the floor under all design conditions. Provide a bottom edge safety device that is integral with the bottom seal.

Design bottom beams to span between safety arrestors at the jambs and support the weight of the door, including intermediate beams, while remaining stable and within the door guides. If the door leaf safety arrestor alternative is utilized per paragraph DOOR LEAF SAFETY ARRESTERS, design the bottom beam to support the weight of the door, including intermediate beams with either end belt/wire rope, or any two intermediate belts/wire ropes, removed while remaining stable and within the door guides. Midspan splices are prohibited in the bottom beam.

2.6 WIND LOCK

At each door leaf provide wind locks at each jamb, which automatically activate and lock the bottom beam into place when the door reaches its closed position to maintain a tight floor seal and intermediate beam stability with tight fabric under design wind conditions. Provide a limit switch, or a proximity switch, with indicator to notify the door operator that all wind locks are engaged properly. Provide switches located below 45.7 cm 18 inches above finish floor that are compliant with NFPA 70, Class I, Division 2 hazardous environment.

[2.7 SWING-UP MULLION WHERE INDICATED

****

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.
****

The swing-up mullions will be designed to swing up under the door leaf in the raised position. They will be constructed of carbon steel and finished in accordance with the paragraph FINISHES. The mullion hinge pivot will be of a maintenance-free bearing design. Provide sufficient length of door guide, between fall arrestors and mullion hinge pivot, to permit door's safety arrestors to fully engage and stop the door from falling in the case of a belt/wire rope break or other failure condition when the door is in the fully open position.

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 will be produced by one manufacturer. Wire rope hoist and secondary system will connect to mullion a minimum of 3.05 m 10 feet above finish floor. Attach using a double shear connection through the mullion. Demonstrate through calculations that the lifting apparatus and its connection to the mullion is designed for all loads. Refer to the paragraph ELECTRICAL OPERATION for controls and interlocks of mullion and door panels.

Swing-up mullion assembly, including lifting arm and wire rope, is not permitted to encroach on required aircraft clear space required by the contract documents.

2.7.1 Mullion Pit and Cover where Indicated

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

Provide a mullion pit frame, guide plate, and cover(s), manufactured of aluminum or steel, for each mullion. Hinged cover plates will be attached to the mullion pit frame. Mullion pit covers will 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 175 square inches.

[2.7.2 Retractable Mullion Pin and Floor Strike

****
NOTE: Include paragraph below when the Government decides to include retractable mullion pins and floor strikes. Recommend discussing with potential manufacturers. Advantages include a significantly smaller mullion pit and covers. Disadvantages include additional cost, maintenance and potential operating issues/errors associated with each motor and limit switch along with design/construction complexities associated with the Class I Division 2 challenges.
****

Provide retractable mullion pin with a heavy duty, reversing electric linear actuator. Design mullion pin and strike to resist all mullion design loads and accommodate all vertical movement of the mullion. Provide a hinged cover at each floor strike, funnel shaped at the top, manufactured of aluminum or steel, accommodate mullion pin size and pin throw, and be designed to support a 155.7 kN 35,000 pound force single wheel load with a tire pressure of 1379 kPa 200 psi and contact area 0.1 square meters 175 square inches. Refer to paragraph LIMIT SWITCHES for information on mullion pin and floor strike limit switches.

]]2.8 PERSONNEL DOOR

[Personnel doors are not required in Hangar doors.

] **********

NOTE: Emergency Exit/Egress doors are no longer permitted to be located in hangar doors in accordance with UFC 4-211-01. Personnel doors for convenient access to the flightline are permitted if provided in accordance with the below paragraph.

****

[Provide personnel doors in door leaves as indicated in the drawings. Provide insulated steel or aluminum personnel doors as specified in Section [08 11 13 STEEL DOORS AND FRAMES] [08 11 16 ALUMINUM DOORS AND FRAMES]. Provide complete personnel door with all hardware including, hinges, lockset, stop, weather stripping, and interlock.

]2.9 OPERATION

2.9.1 Door Operation

Provide a vertical lift fabric door which guides up and down in weather sealed vertical guides attached to the structure[and mullions]. Provide a door system which operates by lifting the bottom beam upwards in each door leaf, thereby stacking the intermediate beams one on top of the other, with the fabric material folding in pleats. Door operational safety is of paramount importance.

When the door system is fully open, all door system components will be outside of the required clearance area for the door opening.

When the door system is fully closed the door system will seal the opening and form a portion of the building's air barrier. The intermediate beams hang between the two fabric faces thus pulling the fabric material tight and sealing along the guides at each jamb. The tension created in the fabric panels is permitted to stabilize the intermediate beams, if proven capable by the manufacturer, and the bottom beam seal will fit tightly along the entire length of the door threshold.

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.

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.

The door will be stopped by a primary limit switch when the door is opened completely. In case of over travel, the door will be stopped by a secondary limit switch to prevent damage. Slack belt/wire rope breakers will stop the drive unit when the door is closed. In case of belt/wire rope break/rupture or if an obstruction should prevent the door from being closed the slack belt/wire rope breakers will also stop the drive unit. Weight or springs activate the slack breakers.

A touch screen (HMI) control panel station is required at the main and at all auxiliary stations.

Control door operation by three buttons marked "OPEN", "CLOSE", and "STOP". The "OPEN" and "STOP" buttons require only momentary pressure to operate. The "CLOSE" button requires constant pressure to maintain the closing motion of the door. The door will immediately stop, and remain in that position, when the door is in motion and the "STOP" button is pressed or the "CLOSE" button is released. From that stop position, the door operation is then continued in either direction by the "OPEN" or "CLOSE" buttons. Removing the pressure from the "CLOSE" button results in stopping the motor drive and setting the brake.

[Two buttons marked "Horizontal Position and Vertical Position" control the mullion operation. Both buttons are controlled by constant pressure to open and to close. Removing the pressure from either button stops the motor drive and sets the brake. The electrical control panel provides an interlock function to coordinate door leaf and mullion operation.

] Buttons are illuminated on the HMI (control panel) and utilize simple flashing/solid illumination schemes to inform the operator of door status (fully open, closed, in motion, etc.). The large touch screen display graphically illustrates the door system to permit the user to select desired operation and inform the user of current door status. Door operation on the HMI (Control Panel) are password protected, by individual user, to prevent accidental or unauthorized operation.

****

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

****

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

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

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

][2.9.3 Backup Door Operation

****

NOTE: At the time of this writing, only one manufacturer is believed to have a system capable of meeting this requirement. Prior to including this paragraph, designer will investigate and confirm if there are adequate door system manufacturers currently available that are able to provide this option and confirm if this option is justified/required for the facility. Coordinate and incorporate space, clearance, utility, infrastructure and other facility requirements with the contract documents.

****

Separate from the connection to a backup power source or emergency generator, provide a door system backup power source and system capable of opening and closing the entire door system at least one time, with complete loss of power to the entire facility. For the purposes of this requirement, the minimum door leaf and mullion speeds indicated in this specification are not applicable.

]2.10 FINISHES

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NOTE: If compliance with UFC 4-211-01 is required, the coating system specified in Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES is required. This specification is very robust and the coating system includes the following:

Prep in accordance with SSPC SP 10/NACE No. 2. Apply Zinc-Rich Epoxy Primer Coat (3-5 mil), Epoxy Intermediate Coat (3-5 mil), and a 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 and galvanizers for large sections are increasingly difficult to locate.

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 anticipated field painting would be touching up damage to the coating occurring during shipping and installation and coating of

accessories such as bolts and brackets.
****

2.10.1 Ferrous Metal

Provide cleaned, prepared and shop-finished ferrous metal surfaces in accordance with Section [09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES] [09 90 00 PAINTS AND COATINGS] [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. Shop finishing of all ferrous metal coatings is required with field coatings limited to touch-up painting and coating of only unfinished accessories such as bolts and brackets.[The following submittals if required by Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES 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

****
NOTE: Specify AAMA 2605 powder coating, or AA-M12-C22-A41 clear (natural) anodized finish, as aluminum door fabric retention components will be subject to excessive wear, abrasion and will not likely be regularly cleaned or maintained. This finish is also appropriate in highly corrosive industrial atmospheres with dust, gases, salts, or other disruptive elements that attack metal.

In the second paragraph below, select the first bracketed choice if aluminum fabric retention components exposed to view are required to match the color of the fabric, otherwise select the second bracketed choice for a clear anodized aluminum finish for fabric retention components.
****

Before fabrication, clean the units and provide the coating system specified below in accordance with the requirements of the Aluminum Association Designation System, AA DAF45.

[Provide an Organic Coating (superior performance exterior coating) complying with the requirements of AAMA 2605. Clean surfaces and pretreat them with a conversion coating before applying 0.0076mm 0.3 mil dry-film thickness of epoxy or acrylic primer according to the recommendations of the finish coat manufacturer. Apply a finish coat of [70 percent] [_____] minimum fluoropolymer resin fused to primed surfaces at the temperature recommended by the manufacturer at a minimum dry film thickness of 0.25mm 1.0 mil. Use a minimum 3-coat or 4-coat system as required for the color selected.][Clear Anodized: Conforming to AA-M12-C22-A41 in accordance with NAAMM AMP 500 and complying with AAMA 611. The minimum finish thickness is 0.0175mm 0.7 mil or greater.]

2.11 SIGNAGE

Provide a placard sign immediately adjacent to all control panels

indicating the below Notice. Include the service level wind speed which corresponds to the ultimate wind speed used in design of the open/operational door in paragraph WIND LOADS in the Notice post..

Notice:

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

Vertical lift fabric doors will 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 will be shop coated and touch-up painted in the field in accordance with the paragraph FINISHES.

3.1.3 Metal Protection

Provide in accordance with Chapter 4 of UFC 1-200-01 when door system is in a corrosion prone location or where door system components use dissimilar metals. If dissimilar metals are used, also provide in accordance with MIL-STD-889. Provide added corrosion protection to the design such as, but not limited to, the following. 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 WELDS

3.2.1 Visual Inspection

Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections in accordance with AWS D1.1/D1.1M. Perform visual inspections on 100 percent of all welds with a Certified Welding Inspector. Document this inspection with the Nondestructive Testing.

Inspect proper preparation, size, gaging location, and acceptability of all welds; identification marking; operation and current characteristics of welding sets in use.

3.2.2 Nondestructive Testing

Perform nondestructive testing in accordance with AWS D1.1/D1.1M[and AWS D1.8/D1.8M]. Perform ultrasonic testing in accordance with Table [6.2] [or 6.3] of AWS D1.1/D1.1M. Test 50 percent of all welds, with sampling representative of all weld types and locations for the entire door system and for the duration of the fabrication schedule. All personnel performing NDT are required to be certified in accordance with ANSI/ASNT CP-189 in the method of testing being performed. Submit certificates showing compliance with ANSI/ASNT CP-189 for all NDT technicians. If more than 10 percent of welds made by a welder contain defects identified by testing, then all groove welds made by that welder are required to be tested by ultrasonic testing, and all fillet welds made by that welder are required to be inspected by magnetic particle testing (MT) or dye penetrant testing (PT). When groove welds made by an individual welder are required to be tested, magnetic particle or dye penetrant testing may be used only in areas inaccessible to ultrasonic testing. Retest all repaired areas. Submit weld inspection report.

3.3 ERECTION

Provide all work associated with these door systems under the direct supervision and control of the fabricator for safety, control of product liability, and Engineer of Record responsibilities. Coordinate the erection of the doors with the work of other trades. Coordinate the design, fabrication and erection of the door systems and adjust for actual camber, fabrication, and erection tolerances of the supporting structure including simulated door weight load testing and survey to ensure proper fit-up of the final door system. Coordinate mullion pit locations (including their drains), alignment and orientation. Ensure that all steel support, bracing and framing members are furnished and accurately installed. Coordinate electrical work, including locations of all panels, equipment, motors and other components for required clearances, access and routing of power.

3.3.1 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 in accordance with paragraph FINISHES.

3.3.2 Cleaning

Clean both the interior and exterior of doors after the completion of erection.

3.3.3 Control Panel Installation

Locate all door control panels indoors, adjacent to the door opening, and with an unobstructed line of sight for the entire door opening. Provide all conduit entries into the bottom of the control panel. Mount control panels and provide three phase power to each control panel.

3.4 ELECTRICAL WORK

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

Door manufacturer to coordinate with the qualified, licensed electrical contractor who will provide and install all [208 3-phase][480 3-phase] supply power to all components (such as Main, auxiliary, controllers, panels, motors, and other electrical devices) which require this low voltage supply power. The qualified, licensed electrical contractor will provide and install all conduit for the control level power under the review and approval of the door manufacturer. Either the qualified, licensed electrical contractor or a factory authorized technician may provide and install all wiring for control level power under the review and approval of the door manufacturer in accordance with the approved construction submittals.

3.5 ACCEPTANCE TESTING PROCEDURE AND REPORT

Submit an Acceptance Testing Procedure for approval, which includes coordination with Section 01 91 00.15 BUILDING COMMISSIONING for such items as hangar door position switches which interact with HVAC controls. After Government approval, perform the testing and submit a report of the results. Provide acceptance testing for the entire door system, including every component, performed by the door manufacturer and suppliers. The following subparagraphs are included in the acceptance testing.

3.5.1 General

Upon completion of installation, including work by other trades, lubricate, adjust, and test doors to verify operation in accordance with manufacturer's product data. Final adjustments will be made by the Manufacturer's authorized representative. 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] 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 a copy of the final acceptance testing report with completed tests.

3.5.2 Door Drop Prevention Demonstration

Perform a non-destructive demonstration of the safety arrester function by slowly engaging the installed safety arresters on the guiderails at a height of 1 m 3 feet above closed position in a controlled manner so as to not fall and not damage any door system components or adjacent structure. Perform demonstration on all door leaves and components in the presence of the Contracting Officer's Representative.

If the door leaf safety arrestor alternative is utilized per paragraph DOOR LEAF ARRESTER ALTERNATIVE, perform a non-destructive demonstration showing the bottom beam is able to support the door with the loss of either end belt/wire rope, or any two intermediate belts/wire ropes, in a safe and controlled manner so as to not fall and not damage any door components or adjacent structure. Perform demonstration on all door leaves and components in the presence of the Contracting Officer's Representative.

3.6 PERSONNEL TRAINING

Provide an 8-hour on-site training session for the door operating personnel and maintenance department. In the training, outline door safety, operation, troubleshooting and repair guidelines.[Record this on-site training and provide a video presented in a coherent fashion such that the Government may use the video as the sole training program for future user operators. In multiple locations throughout the video, specifically mention the door system must be completely closed prior to experiencing 96.6 km/hr 60 mph [_____] wind speeds. It is acceptable to utilize stock training video content in this video provided the door operation, safety and controls are identical to the door system provided.]

3.7 EXTRA MATERIALS

Supply a door fabric patch kit with approximately 4.2 square meters 45 square feet of fabric for each hangar door and all other materials required for door panel repair. Provide all unique tools required to maintain the door system. Provide a patch kit with color matched fabric and associated repair materials and tools.

3.8 INSPECTION AND ADJUSTMENT

Within the 12 month warranty period, following the initial period of use and changes in seasonal temperature, the manufacturer's authorized representative will return to inspect and adjust doors to confirm the door system is fully operational and acceptable. Provide the Contracting Officer's Representative an inspection report outlining observations, door condition, operation, and all items requiring adjustment or requiring repair/replacement under the door system warranty. Include a report with recommended annual inspection and maintenance items. As needed, schedule a follow-up visit to complete items requiring adjustment, repair or replacement. Manufacturer is responsible for items requiring adjustment, repair or replacement for the 3 year maintenance-free warranty period or 1500 cycles, whichever occurs first, beginning after the first 12 month contractor's warranty period.

-- End of Section --