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USACE / NAVFAC / AFCEA / NASA UFGS-08 34 16.10 (April 2006)

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 18 July 2006

Latest change indicated by CHG tags

SECTION 08 34 16.10

STEEL SLIDING HANGAR DOORS 04/06

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

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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

NOTE: On the drawings, show:

1. Size and arrangement of doors. Electrical and structural provisions for motor operators.
2. Location and type of weather stripping, exterior covering, interior lining, and flashing.
3. Location, spacing, size, and type of top guides and rails. Center-to-center dimension of leaves not less than **350 mm 14 inches**, and not less than **115 mm 4 1/2 inches** greater than total thickness of each

leaf, including interior and exterior coverings. Where electrical trolley duct is required between leaves, provide additional 150 mm 6 inches of clearance. Where cable system is required between leaves, provide additional 25 mm one inch of clearance.

4. Location and type of personnel doors. Do not locate personnel doors between wheels and edge of hangar door leaf. Exact location to be determined by structural design of door leaf.

5. Location of bumpers and pulls.

6. That wheels will be required. Type, size, and number should not be shown since size and weight of doors will determine these.

7. Wind loads on both sides of doors and positive and negative deflection of top guides due to live loads.

8. Details of expansion joints in rails and top guides where building expansion joints occur.

9. Electrical service for motor operators, preferably 460 volts, 3-phase, 60-hertz, and location of power supply disconnect.

10. Festooned or draped cables or cable reels.

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

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

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

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

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

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

17. Rail drains for full length of bottom rails. This may be done with cross drains normal to the rails spaced about 6000 mm 20 feet o.c. emptying into continuous parallel floor drain. In cold areas it may be necessary to provide defrosting equipment below rails.

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

PART 1 GENERAL

1.1 REFERENCES

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 RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 335 (1989) Structural Steel Buildings
Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-973 (2002) Cold-Formed Steel Design Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M (2005) Carbon Structural Steel

ASTM A 366/A 366M (1997e1) Commercial Steel, Sheet,
Carbon, (0.15 Maximum Percent Cold-Rolled

ASTM A 569/A 569M (1998) Steel, Carbon (0.15 Maximum

Percent), Hot-Rolled Sheet and Strip,
Commercial

ASTM A 653/A 653M (2004a) Steel Sheet, Zinc-Coated
(Galvanized) or Zinc-Iron Alloy-Coated
(Galvannealed) by the Hot-Dip Process

ASTM C 920 (2005) Elastomeric Joint Sealants

ASTM E 84 (2005) Surface Burning Characteristics of
Building Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (2000; R 2005) Industrial Control and
Systems: General Requirements

NEMA ICS 2 (1996; R 2004) Standard for Industrial
Control and Systems: Controllers,
Contractors, and Overload Relays Rated Not
More than 2000 Volts AC or 750 Volts DC:
Part 8 - Disconnect Devices for Use in
Industrial Control Equipment

NEMA ICS 6 (1993; R 2001) Industrial Control and
Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2005) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25 (1997; R 2004) Zinc Oxide, Alkyd, Linseed
Oil Primer for Use Over Hand Cleaned
Steel, Type I and Type II

SSPC SP 6 (2000; R 2004) Commercial Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 506 (2000; Rev thru Feb 2004) Specialty
Transformers

1.2 DESIGN REQUIREMENTS

1.2.1 Door Design

[The hangar doors shall be designed by the manufacturer in accordance with the criteria specified.] Doors shall operate without binding, interference, or damage to weatherstripping. Doors shall fit closely and be free from warping.

1.2.2 Steel Design

AISC 335, AISI SG-973.

1.2.3 Loading

Design doors as a system to withstand an external wind load of **one kilopascal 20 pounds per square foot (psf)** or the design wind load indicated for the building, whichever is greater, and an internal wind load of not less than one-half of the external wind load. In both cases, the deflection shall not exceed the height of the door divided by 120. The deflection due to design wind load shall not exceed length divided by 120 for any door member. Fiber stresses due to combined dead load and wind load shall not exceed the recommended design stresses for the material used and type of loading sustained.

1.2.3.1 Deflection

Design doors as a system to withstand the upward and downward deflections of the cantilevered structure supporting and bracing the top of the hangar door system.

- a. Positive deflection (wind uplift) - **76 mm 3 inches**
- b. Negative deflection (live load) - **254 mm 10 inches**

1.2.4 Connections

Design connections at top and bottom guide rails to withstand an external and an internal wind load of not less than **1.54 kPa 33 psf**, or the design wind load for the building, whichever is greater, and a seismic load equal to 0.5 times the weight of the door.

1.2.5 Cold-Formed Steel Members

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

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hangar doors[; G][; G, [____]]

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

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

SD-05 Design Data

Hangar doors[; G][; G, [____]]

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

SD-10 Operation and Maintenance Data

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

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

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer's Qualifications

The hangar door manufacturer shall be one who is regularly engaged in the production of steel sliding hangar doors of type and size required for this project.

1.4.2 Installer's Qualifications

The installation supervisor shall be an authorized representative of the

door manufacturer. Mechanics shall be skilled and experienced in the erection of hangar doors of type and size required for this project.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.1 HANGAR DOORS

2.1.1 Structural Steel

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

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

"1 Top Guides and Bottom Rails for Hangar Doors:

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

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

.1.3 Bottom Rails: Standard A.S.C.E. or A.R.E.A. weighing not less than [_____] kilograms per meter pounds per yard. Do not install rails until top guide system has been installed. Anchor rails as indicated. Set rails to elevation within plus or minus 6 mm 1/4 inch, with variations from elevation no greater rate than one mm in 2 meters 1/8 inch in

20 feet. Nominal design relationship between top guides and bottom rails to be maintained without exception. Center-to-center dimensions of bottom rails to be maintained within plus or minus 3 mm 1/8 inch with variation from nominal no greater than one mm in 2 meters 1/8 inch in 20 feet. Weld rail joints and grind smooth or provide with splice plate in accordance with ASCE standards."

AISC 335 and ASTM A 36/A 36M.

2.1.2 Formed Steel

AISI SG-973.

2.1.3 Sheet Steel

ASTM A 569/A 569M hot-rolled steel sheet, commercial quality, or
ASTM A 366/A 366M cold-rolled steel sheet, commercial quality.

2.1.4 Galvanized Steel

ASTM A 653/A 653M, coating designation G 90 galvanized steel sheet, commercial quality.

2.1.5 Exterior Covering

NOTE: Choose one of the following options.

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

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

[Preformed metal siding as specified in Section 07 41 13 METAL ROOF AND
WALL PANELS.]

2.1.6 Interior Covering

NOTE: Choose one of the following options.

NOTE: Designer's Options. Use the first paragraph if the covering is to be provided by the hangar door

manufacturer, as when new doors are required for an existing building. Use the second paragraph if the hangar doors are a part of a new building which will have preformed metal liner panels. Ascertain that the project specification contains the referenced section and that the section is edited to include the covering for the hangar doors.

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

[Preformed metal siding is specified in Section 07 41 13 METAL ROOF AND WALL PANELS.]

2.1.7 Insulation

NOTE: Choose one of the following options.

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

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

[Provide insulation that:

- a. Contains no asbestos;
- b. Is permanently secured in place behind the exterior covering; and
- c. Has a flame spread rating of 75 or less and a smoke-developed rating of 100 or less when tested in accordance with ASTM E 84.

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

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

2.1.1.8 Hardware

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

2.1.1.8.1 Wheel Assemblies

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

- a. Treads: Machine wheel treads concentric with bearing seats. The clear distance between flanges shall not exceed the width of the rail by more than 3 mm 1/8 inch at the tread nor more than 6 mm 1/4 inch at the edge of the flange. Machine internal bearing seats accurately for a press fit. Heat treat wheels 450 mm 18 inches or greater in diameter to obtain a rim hardness of 320 Brinell.
- b. Wheel bearings: Provide tapered roller or spherical bearings, either internal or cartridge type, arranged so that both horizontal and vertical loads shall be transferred to the rail only through the bearing. Bearings shall be tightly sealed and equipped with high-pressure grease fittings.

2.1.1.8.2 Fixed Pancake Top Guide Rollers

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

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

2.1.1.8.3 Vertical Floating Head Top Guide Rollers

Provide top-roller assemblies to:

- a. Move up and down within the specified live load positive and negative deflection of the roof in the vicinity of the door opening;
- b. Allow easy removal through the top of the guide system; and
- c. Include both horizontal and vertical rollers built into a frame which is connected in such a manner as to transmit the specified wind loads from the door to the hangar structure and to prevent disengagement of the door from the top guide.

[Rollers shall be stainless steel.]

2.1.9 Personnel Doors

NOTE: Personnel doors, their frames, and hardware shall be specified in the respective sections of the project specification. Provide self closing door hardware.

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

2.1.9.1 Doors and Frames

Specified in Section 08 11 13 STEEL DOORS AND FRAMES.

2.1.9.2 Hardware for Personnel Doors

Specified in Section 08 71 00 DOOR HARDWARE.

2.1.9.3 Electrical Interlock

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

2.1.10 Weather Stripping

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

2.1.10.1 Neoprene

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

2.1.10.2 Metallic

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

2.1.10.3 Hanging Head Flashing

NOTE: Delete paragraph if hangar doors have vertical floating top rollers. Hanging head flashing must be designed and fabricated to

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

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

2.1.11 Fasteners

Either zinc-coated or cadmium-plated steel.

2.1.12 Sealant

Single-component or multicomponent elastomeric type conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Provide a sealant that has been tested on the types of substrate to which it will be applied.

2.1.13 Primer

Red iron oxide, zinc oxide type, SSPC Paint 25.

2.1.14 Starters

Provide magnetic reversing starters in NEMA ICS 1, Type 12 enclosures equipped with access door-controlled, fused safety disconnect switches. Starters shall be factory wired with overload and undervoltage protection, mechanical and electrical interlocks, auxiliary contacts, relays and timing devices as required, control circuit transformers, and a numbered terminal strip. The control circuit transformer shall reduce the voltage in the control circuits to 115 volts or less, and shall conform to UL 506.

2.1.15 Electrical

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

2.2 FABRICATION

2.2.1 Doors

2.2.1.1 Frames and Framing

Door leaves shall be of welded or bolted construction. Joints shall develop 100 percent of the strength of the framing members. Vertical members shall be continuous throughout the height of the door. When

required, prepare splices to facilitate field assembly in accordance with standard practice. Frames and framing members shall be true to dimensions and square in all directions; no leaf shall be bowed, warped, or out of line in the vertical or horizontal plane of the door opening by more than **one mm in 2 meters 1/8 inch in 20 feet**. Provide diagonal bracing so that the completed leaf assembly will be braced to withstand shipping, assembly, and operational loads. Exposed welds and welds which interfere with the installation of various parts such as cover sheets shall be ground smooth.

2.2.1.2 Exterior Covering and Interior Liner Sheets

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

2.2.2 Locking Devices

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

2.2.3 Tractor Pulls

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

2.2.4 Track Cleaners

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

2.2.5 Insulation

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

2.2.6 Cable System for Group Doors

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

2.3 OPERATION

NOTE: Type of operation will depend upon use and configuration of the hangar. Delete inapplicable paragraphs.

2.3.1 Hangar Door Types

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

2.3.1.1 Individually Operated Doors

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

2.3.1.2 Floating Group Doors

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

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

2.3.1.3 Anchored Group Doors

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

2.3.2 Operating Units

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

Each operating unit shall move its [lead] leaf at a speed of approximately 20 meters 60 feet per minute at zero wind load conditions and to be operable up to and including a maximum wind load of 0.4 kilopascals 8 pounds per square foot. The operating units shall consist of either a separate motor and gear reducer or a gearhead motor, high-speed shaft brake, and necessary roller chains and sprockets. The systems shall be provided with overload protection for the drive units and a means for emergency tractor towing operation.

- a. Motors shall be single speed, squirrel-cage type of sufficient size to operate the leaves under zero wind load conditions at not more than 75 percent of their rated capacity.

- b. Gear reduction units shall allow a reversal of effort through the gears without damage to the units.
- c. Operating mechanisms shall be covered on the interior of the leaf by a hinged 1.5 mm thick 16 gage flat steel cover.

2.3.3 Braking Systems

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

2.3.4 Controls

Doors shall be controlled by constant pressure push buttons mounted on the door leaves. Removing pressure from the button shall stop the movement of the leaves. The control equipment shall conform to NEMA ICS 1 and NEMA ICS 2. Interior push buttons shall be mushroom head type, mounted in heavy-duty, oil-tight enclosures conforming to NEMA ICS 6, Type 13, except that enclosure for reversing starter with disconnect switch shall be Type 1 or Type 12. [Exterior push buttons shall be in watertight enclosures conforming to NEMA ICS 6, Type 4.]

2.3.4.1 Push Buttons for Individually Operated Doors

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

2.3.4.2 Push Buttons for Floating Group Doors

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

2.3.4.3 Push Buttons for Anchored Group Doors

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

2.3.5 Limit Switches

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

2.3.5.1 Plunger-Type Limit Switches

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

2.3.5.2 Lever Arm Type Limit Switches

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

- a. Positive acting, snap action, lever arm type with actuating cams designed with sufficient overtravel to permit the group to come to a complete stop without overtraveling the limit switches.
- b. Mounted on the leaves, and the actuating cams mounted either on the top guides or on adjacent door leaves.

2.3.6 Safety Edges

NOTE: Edit to suit type of door operation required.

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

- a. Design: Provide safety edges to provide a minimum of 90 mm 3 1/2 inches of overtravel after actuation until solid resistance is met and door motion comes to a complete stop. If door requires more than 90 mm 3 1/2 inches to come to a complete stop, provide additional overtravel built into safety edge the distance required for door motion to come to a complete stop. Use electric safety edges.
- b. Specs: Use sensing edges of reinforced polyvinyl chloride cover or other Government-approved material with chemical resistance to diesel and JP-4 fuel, hydraulic fluids, SAE-30 oil and salt water. Use cover that provides hermetic seal for weather and moisture resistant protection of internal foam and contact elements. Internal foam may be polyurethane and/or latex foam per military specification MIL-R-5001, medium density. Use two contact elements separated by perforated foam or other Government-approved materials and design to perform the switching function

when the sensing edge encounters an obstruction along any portion of its active length.

- b. Operation: Actuation of the safety edge on leading edge of a group of leaves shall stop movement of the group. Actuation of a safety edge shall lock out the motor control in the direction of travel until reset, but shall permit the door to be reversed away from the obstruction which tripped the safety edge. Safety edges shall be alive only when doors are moving. Safety edges shall be reset by moving doors away from the obstruction. The lower portion of the safety edges to a height of approximately 1500 mm 5 feet shall be independently removable for convenience in servicing or repair. The remainder of the edge may be in one piece up to a maximum of 6000 mm 20 feet.
- c. Bumper(s): Each door leaf edge provided with a safety edge shall be protected by a spring type bumper(s). Bumper shall be designed to absorb 150 percent of the door drive force when door is pushed in an emergency. For continuous safety edges, bumpers shall extend to the sides. For sectional safety edges, the bumper can interrupt the safety edge for a distance not greater than 305 mm 12 inches.
- d. Keyed bypass: Provide a keyed bypass to the door controls to render the safety edges in a temporary "repair" mode, if necessary. The door drive shall be restored from its "fail safe" mode by activation of the keyed bypass.

2.3.6.1 Electrical Safety Edges

Connect the safety edge in series with the necessary relays and resistors to make the system complete. The service shall be not more than 24 volts and the circuit shall be normally energized so that the malfunction of any of the component parts will make the door inoperative. Wire sensing edges to provide for control reliable 4-wire operation of hangar door so that any power loss to the sensing edges is experienced, then the door becomes inoperable until power is restored and a reset operation is initiated. Install sensing edges to operate through a normally energized relay so that when the sensing edge is compressed the relay contacts open. Install relay contacts to also open if any component in the sensing edge control circuit is broken so as to break continuity. Use 100 volts electrical service to the control circuit. Ensure service to the sensing edge does not exceed a nominal 24 volts. Install a large red indicator light and/or a loud siren, to be simultaneously activated with the actuation of any sensing edge, to indicate the presence of an obstruction.

2.3.7 Warning Device

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

- a. Operate when the push button is actuated for movement of the door in either direction;
- b. Sound 5 seconds before the door moves, and while the door is moving; and
- c. Consist of not less than a 150 mm 6 inch diameter bell or equivalent decibel-rated horn, loud enough to be heard in the

hangar and on the apron.

2.3.8 Emergency Operation

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

2.3.9 Electrical Work

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

"HANGAR DOORS: Provide field wiring [and trolley duct installation] for hangar doors under this section in accordance with door manufacturer's written instructions, drawings and diagrams, and NFPA 70 and NEMA ICS 1. Provide conduit, wiring, boxes, cables, devices, and accessories under this section. If permanent electrical power is not available when door installation is complete, provide temporary power for testing and adjusting doors for proper operation. [Trolley ducts will be furnished by door manufacturer and installed under this section in accordance with door manufacturer's approved drawings.] [Draped or festooned cables or cable reels shall be provided under this section. Cable shall be extra-flexible Type SD, and shall have a spring-loaded, automatic take-up reel, coil-cord, draped cable, or equivalent device.] [as indicated.]"

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

2.3.9.1 Trolley Ducts

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

in accordance with door manufacturer's drawings.
Only door manufacturer is properly qualified to know
where to place trolley duct so there is adequate
clearance and noninterference.

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

- a. Each run shall consist of the required number of sections of straight track, a section of dropout track, feed boxes, end caps, couplings, hangers, and other accessories to make the system complete and workable. Provide expansion tracks in each run where the system crosses a building expansion joint in the roof construction and in the top guides.
- b. Furnish one track-supported tandem trolley or self-supporting collector for each [individually motor-operated door] [group of doors], complete with spring-loaded brush contacts. Provide trolley pulling brackets and corrosion-protected chains attached from each side of the pulling bracket to each side of the tandem trolley or support bracket for self-supporting collectors.

2.3.9.2 Electrical Cables

NOTE: Draped or festooned cables and cable reels
should be specified to be furnished and installed
under Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM.

Flexible cables or cable reels shall be provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, in accordance with the door manufacturer's approved drawings and wiring diagrams.

PART 3 EXECUTION

3.1 PROTECTIVE COATINGS

NOTE: Painting of hangar doors must be specifically
mentioned in Section 09 90 00, PAINTS AND COATINGS,
along with instructions not to paint operating
parts, mechanisms, limit switches, or trolley ducts.

3.1.1 Cleaning

After fabrication, clean metal surfaces in accordance with SSPC SP 6 (Commercial Blast).

3.1.2 Shop Painting

After cleaning, coat steel surfaces other than machine-finished parts with priming paint. Keep paint off of finished bearing surfaces. Before assembly, prime surfaces that will be inaccessible after assembly. Handle

painted materials with care to avoid scraping or breaking the protective film. Make match-marks on painted surfaces only.

3.2 ERECTION

Assemble doors and accessories in accordance with approved shop drawings. Do not erect doors until the work of other trades in preparing the opening has been completed, the hangar roof is under full dead load, and the top guide and rail systems are within specified tolerances. After completing erection and before starting field painting, clean interior and exterior door surfaces. Clean abraded surfaces, field welds, and field bolts; and coat with priming paint. Field painting as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 FIELD QUALITY CONTROL

3.3.1 Manufacturer's Field Services

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

3.3.2 Tests

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

-- End of Section --