

COMMERCIAL STANDARDS ~~CS231 A-E~~ D-63
ON AIRCRAFT HANGAR DOORS

Fact Sheet

In March 1958, the Hangar and Industrial Door Technical Council requested the cooperation of the Commodity Standards Division, National Bureau of Standards in establishing a series of commercial standards for hangar and industrial doors. **These standards, listed below, are no longer valid and were withdrawn October 2, 1973.**

CS231A-60, Aircraft Hangar Doors of the Manually-Operated Horizontal Sliding Type (Steel Frame),

CS231B-61, Aircraft Hangar Doors of the Individually Power-Operated Horizontal Sliding Type (Steel Frame),

CS231C-63, Aircraft Hangar Doors of the Partial-Group Power-Operated Horizontal Sliding Type (Steel Frame),

CS231D-63, Aircraft Hangar Doors of the Full Group Power-Operated Horizontal Sliding Type (Steel Frame), and

CS231E-63, Aircraft Hangar Doors of the Power-Operated Horizontal Unbraced-Canopy Type (Steel Frame).

The Hangar and Industrial Door Technical Council is no longer in existence.

The Federal Aviation Administration (FAA) may be able to provide assistance and information concerning current standards and requirements. Contact: Engineering and Specifications Division (622A), Office of Airport Safety and Standards, Federal Aviation Administration (FAA), 800 Independence Avenue, SW, Washington, DC 20591; Telephone: (202) 267-3826/-3053; Fax: (202) 267-3505/-3507.

Federal Register



National Bureau of Standards

VOLUNTARY PRODUCT STANDARDS

Notice of Withdrawal

In accordance with § 10.12 of the Department's "Procedures for the Development of Voluntary Product Standards" (15 CFR Part 10, as revised; 35 F.R. 8349 dated May 28, 1970), notice is hereby given of the withdrawal of the seven standards identified below:

CS 231A-60, "Aircraft Hangar Doors Manually-Operated Horizontal Sliding Type (Steel Frame)"

CS 231B-61, "Aircraft Hangar Doors of the Individually Power-Operated Horizontal Sliding Type (Steel Frame)"

CS 231C-63, "Aircraft Hangar Doors of the Partial Group Power-Operated Horizontal Sliding Type (Steel Frame)"

CS 231D-63, "Aircraft Hangar Doors of the Full Group Power-Operated Horizontal Sliding Type (Steel Frame)"

CS 231E-63, "Aircraft Hangar Doors of the Power-Operated Unbraced-Canopy Type (Steel Frame)"

SPR 258-56, "One-Pound Eastern Flat Margarine Carton"

SPR 261-58, "One-Pound Elgin-Style Butter Carton Sizes"

This action is taken in furtherance of the Department's announced intention, as set forth in the public notice appearing in the FEDERAL REGISTER of March 3, 1972 (37 FR 4459), to withdraw these seven standards.

The effective date for the withdrawal of these standards will be October 2, 1973. This withdrawal action terminates the authority to refer to these standards as voluntary standards developed under the Department of Commerce Procedures.

Date: July 30, 1973.

RICHARD W. ROBERTS,
Director.

[FR Doc. 73-16036 Filed 8-2-73; 8:45 am]

COMMERCIAL STANDARD CS231D-63

**Aircraft Hangar Doors of the Full
Group Power-Operated Horizontal
Sliding Type (Steel Frame)**

A recorded
voluntary standard of the
trade published by
the U.S. Department
of Commerce



WITHDRAWN

For sale by the Superintendent of Documents
U.S. Government Printing Office, Washington 25, D.C. Price 15 cents

U.S. DEPARTMENT OF COMMERCE

OFFICE OF TECHNICAL SERVICES

Commodity Standards Division

With the cooperation of the
National Bureau of Standards
and the Federal Aviation Agency

EFFECTIVE DATE

Having been passed through the regular procedures of the Commodity Standards Division, and approved by the acceptors hereinafter listed, this Commercial Standard is issued by the U.S. Department of Commerce, effective April 15, 1963.

LUTHER H. HODGES, *Secretary.*

COMMERCIAL STANDARDS

Commercial Standards are developed by manufacturers, distributors, and users in cooperation with the Commodity Standards Division of the Office of Technical Services and with the National Bureau of Standards. Their purpose is to establish quality criteria, standard methods of test, rating, certification, and labeling of manufactured commodities, and to provide uniform bases for fair competition.

The adoption and use of a Commercial Standard is voluntary. However, when reference to a Commercial Standard is made in contracts, labels, invoices, or advertising literature, the provisions of the standard are enforceable through usual legal channels as a part of the sales contract.

Commercial Standards originate with the proponent industry. The sponsors may be manufacturers, distributors, or users of the specific product. One of these three elements of industry submits to the Commodity Standards Division the necessary data to be used as the basis for developing a standard of practice. The division by means of assembled conferences or letter referenda, or both, assists the sponsor group in arriving at a tentative standard of practice and thereafter refers it to the other elements of the same industry for approval or for constructive criticism that will be helpful in making any necessary adjustments. The regular procedure of the division assures continuous servicing of each Commercial Standard through review and revision whenever, in the opinion of the industry, changing conditions warrant such action.

SIMPLIFIED PRACTICE RECOMMENDATIONS

Under a similar procedure the Commodity Standards Division cooperates with industries in the establishment of Simplified Practice Recommendations. Their purpose is to eliminate avoidable waste through the establishment of standards of practice for sizes, dimensions, varieties, or other characteristics of specific products; to simplify packaging practices; and to establish simplified methods of performing specific tasks.

Aircraft Hangar Doors of the Full Group Power-Operated Horizontal Sliding Type (Steel Frame)

1. PURPOSE

1.1 The purpose of this Commercial Standard is to establish nationally recognized minimum requirements for design, materials, fabrication, assembly and installation of Aircraft Hangar Doors of the Full Group Power-Operated Horizontal Sliding Type. It is intended to serve as a basis for the preparation of detailed individual job specifications by architect-engineers, and as an aid and guide to producers, contractors and others interested in the product.

2. SCOPE

2.1 This standard covers the minimum requirements for structural and operational design, materials, methods of construction, and installation features. It defines this style of door, and states what the manufacturer provides as the completed door.

2.1.1 This standard covers primarily the fabrication of hangar doors; however, it should be understood that the doors cannot be expected to operate satisfactorily unless the door opening is properly prepared according to the manufacturer's recommendations. Therefore, certain requirements related to the work of other trades are given in the appendices and it will be necessary that these be adhered to in order to obtain the hangar door manufacturer's guarantee; see Section 4.2 and Appendices A & B. Customary methods of inspection after installation are described in Appendix C.

3. DEFINITION

3.1 A full group power-operated horizontal sliding type aircraft hangar door is a group of leaves supported on bottom rails meeting all of the following conditions:

- a) All leaves of a group slide to one side (see Paragraph 3.2—"Arrangement of Leaves").
- b) A traction of fixed chain drive (see Paragraph 3.3—"Type and Location of Operator").
- c) All leaves of a group interconnected with one another by means of a cable system, which is anchored to the building jamb (see Section 3.4—"Cable Systems").

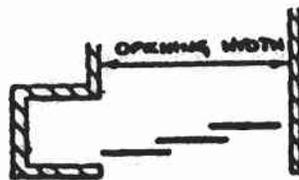
3.1.1 **Operator.**—For purposes of this standard, the operator is the power unit used to position the doors.

3.2 Arrangement of Leaves.—Leaves may be arranged for uni-directional or bi-parting operation as described below.

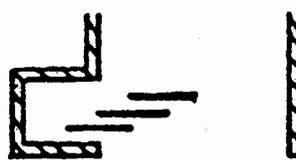
a) **Uni-Directional Arrangement.**

Consists of one full group having:

1. all leaves traveling to one side.
2. all leaves interconnected by a wrap-around or linear cable system.
3. the cable system anchored to the building.
4. a single operator.
5. all leaves moved simultaneously at differential speeds, arriving at the fully opened or fully closed position together.



DOORS FULLY CLOSED



DOORS PARTIALLY CLOSED



DOORS FULLY OPENED



DOORS FULLY CLOSED

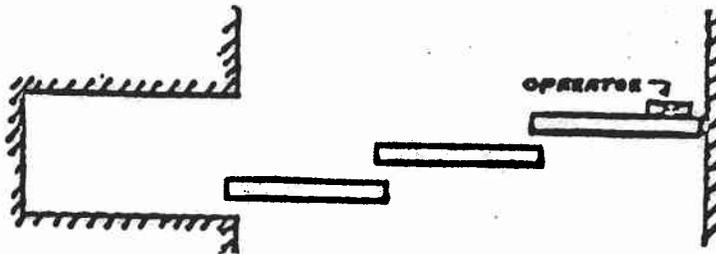
b) **Bi-Parting Arrangement.**

Consists of two full groupings, described under paragraph 3.2 a; with one group traveling to the left and the other traveling to the right.

NOTE: Leaf arrangements shown are for illustration purposes only. Other arrangements are also permissible.

3.3 Type and Location of Operator.

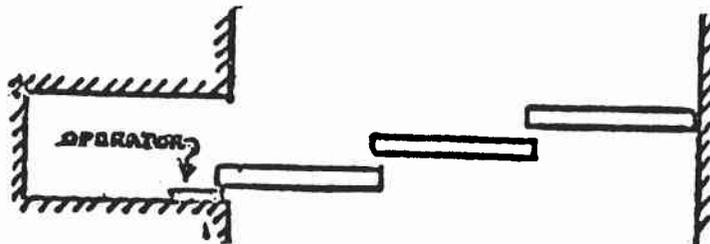
- a) **Traction Drive.**—The operator, mounted on a leaf of the group, drives one or more wheels by roller chain and sprocket mechanism. Idler leaves are interconnected by cables.



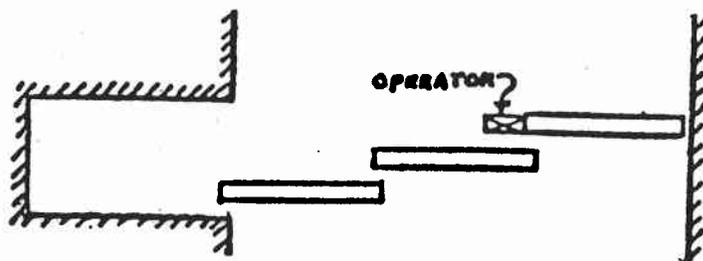
TRACTION DRIVE

- b) **Fixed Chain Drive.**

1. **Fixed Support.**—The operator, mounted on a fixed support at the jamb, drives a sprocket engaging a fixed chain attached to an adjacent leaf. Idler leaves are interconnected by cables.
2. **Leaf Support.**—The operator, mounted on one of the leaves of the group, drives a sprocket engaging a fixed chain attached to an adjacent leaf or wall. Idler leaves are interconnected by cables.



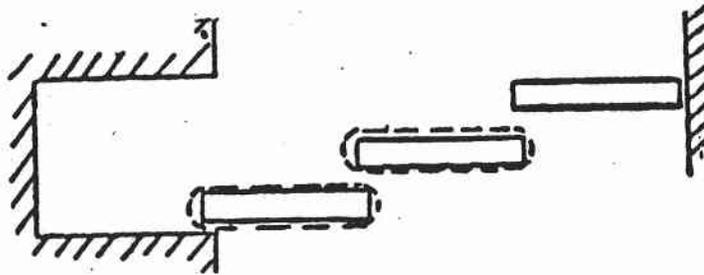
FIXED CHAIN DRIVE FIXED SUPPORT



FIXED CHAIN DRIVE LEAF SUPPORT

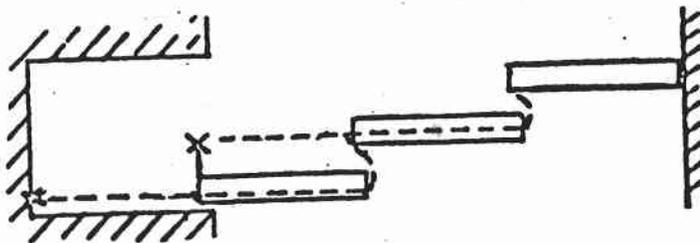
3.4 Interconnecting Cables.

- a) **Wrap-around System.**—Consists of a continuous horizontal cable passing around the periphery of each idler leaf. By means of these cables, all leaves are interconnected to produce differential speeds.

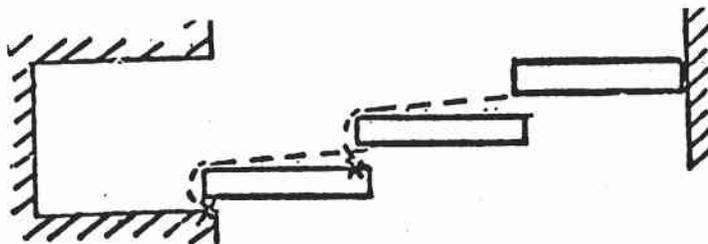


WRAP-AROUND SYSTEM

- b) **Linear System.**—A modification of the wrap-around system consisting of two separate horizontal lines of cables, one for opening and one for closing, mounted on the interior face of each idler leaf, so that no cables or sheaves are exposed on the exterior face of the group. By means of these cables all leaves are interconnected to produce differential speeds.



LINEAR SYSTEM-OPENING



LINEAR SYSTEM-CLOSING

4. GENERAL REQUIREMENTS

4.1 **Approval Drawings.**—The door manufacturer shall submit for approval, the proper authority as specified in the individual job specification, three sets of drawings showing general arrangement of the door, hardware, operators, wiring diagrams, and schematic drawing of electrical controls, as they are related to the completed structure. Structural steel details affecting any door requirements shall be submitted to the door manufacturer for his review, coordination and approval.

4.2 **Responsibilities.**—The door manufacturer shall furnish all labor, materials, tools, equipment, and services required for the fabrication and installation of Full Group Power-Operated Horizontal Sliding Type Hangar Doors. The door manufacturer shall not pro-

vide top guides and supports; bottom rails and their ties; end of travel bumpers; the electric wire, conduit and accessories, and wiring labor required for door operation; the preparation of building jambs and head for the attachment of weathering material; glazing; field paint; or master-keyed cylinders. On cantilever-roof type hangars the metal weather stripping material which attaches to the top guide system is not included as part of the finished door (see Appendix A).

4.3 Shop Paint.—All steel, all inaccessible surfaces, all miscellaneous parts, and hardware shall be shop primed. This paint shall be a high quality commercial grade steel primer as required in the individual job specifications. All steel shall be cleaned prior to painting to remove all oil, rust, and other foreign material.

NOTE: The shop coat of paint is a priming coat intended to protect the steel for a temporary period of weathering only, and to provide a base for further painting. The door manufacturer does not assume responsibility for the deterioration that may result from extended exposure to the elements.

4.4 Weather Stripping Material.—Material, which is adjustable and readily replaceable, shall be provided on necessary vertical edges, sills, and heads to afford a substantially weather tight installation.

4.4.1 Non-metallic Weather Stripping Material.—Material on vertical edges and sills shall be wipe-type, two-ply cloth-inserted 100% neoprene as required in the individual job specifications. The material shall have a minimum thickness of $\frac{1}{8}$ inch and shall be retained continuously for its full length and secured with rust-resistant fasteners on 9 inch centers. Clearance between metal parts on vertical edges of leaves, and between leaves and jambs, which are to be weathered, shall not be less than 4 inches.

4.4.2 Metallic Weather Stripping Material.—Except on doors for cantilever-roof type hangars, head weather stripping material between each leaf and the top guide system shall be formed of not less than 22 gage¹ galvanized steel sheet (see Fig. 1). (For cantilever-roof type hangars see Appendix A.)

4.5 Insulation.—When required, insulation shall be furnished by the door manufacturer, except where the insulation is part of a sandwich panel which is furnished by others. The insulation shall meet the requirements of the geographic location and design as established in the individual job specification. It shall be installed in accordance with the insulation manufacturer's recommendations, and the insulation shall be protected by liner sheets to a minimum height of 6 feet above the floor.

4.6 Workmanship.—All components furnished by the manufacturer (see par. 4.2) shall be free from defects that affect the serviceability or the appearance of the completed unit.

4.7 Maintenance Information.—Recommendations or instructions for proper maintenance of the door shall be furnished by the door manufacturer for the guidance of the purchaser.

5. DETAIL REQUIREMENTS

5.1 Design Criteria.—Leaves shall be designed and constructed of standard structural sections or formed plates of ample size and strength

¹ Galvanized sheet steel gage, thickness 0.0336 inches within commercial tolerances.

for loads and stresses imposed under specified conditions in accordance with the latest applicable American Institute of Steel Construction Specifications.² Leaves shall be designed to withstand the minimum external or internal wind loads specified in ASA A58.1-1955,³ but at no time shall the minimum be less than 20 pounds per square foot, with a wind load deflection not to exceed the door height in inches divided by 120.

5.2 Materials.—All framing members shall be either standard structural sections or formed plates. Structural sections and formed plates shall comply with the latest American Iron and Steel Institute Specifications.⁴ Flat external door covering shall be a commercial quality prime steel sheet, not less than No. 13 gage.⁵ Other types of covering material are acceptable when dictated by architectural treatment; however, due consideration must be given to framing design and clearance. When aluminum covering is used, the contact face of the frame shall have a protective coating to eliminate any possibility of electrolysis. All materials shall be of grades which equal or exceed requirements established by the American Society for Testing and Materials.⁶

5.3 Door Leaf Construction.

5.3.1 General.—Leaf sections in sizes suitable for convenient shipping shall be of welded construction and all joints shall develop 100% of the strength of the framing members. An alternate and equally acceptable construction is one in which members are prefabricated for field assembly. Under this alternate method of construction, framing members can be either welded or bolted. If bolting is used, rib or high strength bolts must be used for fastening main members. Common bolts are satisfactory for secondary members.

5.3.2 Fabrication.—Vertical members shall be continuous throughout the height of the door. Vertical members adjacent to each other and being joined together in the field shall be accurately prepared to facilitate field assembly in accordance with standard practice. All frames and framing members shall be true to dimension and square in all directions, and no leaf shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening, by more than $\frac{1}{8}$ inch in 20 feet so as to allow clearance between leaves. To stiffen the back flange of all main vertical members, full depth members or adequate horizontal gusset plates at the one-third points, shall be considered minimum lateral support. Diagonal bracing shall be provided so that the completed leaf assembly will be adequately braced to withstand shipping, assembly, and operational loads. Exposed welds and welds which interfere with the installation of various parts, such as cover sheets and sash, shall be ground smooth. Where flat cover sheets are used they shall be sealed with a mastic or caulking compound of a quality as required in the individual job specifications and fastened to the frame either by welding, spot welding, threaded fasteners or drive fasteners on 9 inch centers. Where flat sheets are attached at either covering or liner sheets, the clear unsupported area

² Available from American Institute of Steel Construction, 101 Park Avenue, New York 17, N.Y.

³ Available from American Standards Association, 10 E. 40th Street, New York 16, N.Y.

⁴ Available from American Iron and Steel Institute, 150 E. 42nd Street, New York 17, N.Y.

⁵ U.S. Gage, thickness 0.0897 inches within commercial tolerances.

⁶ Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia 3, Pa.

shall not exceed 25 square feet. All outside edges of cover sheets shall be made weather tight before shop painting.

5.4 Sash Inserts.—When required, all sash shall be of standard commercial fixed type construction suitable for glazing in accordance with standard practice. All outside edges of sash shall be made weather tight before shop painting. Sash shall be either welded or through bolted to the door leaf frame on 9 inch centers.

5.5 Personnel Doors.—The manufacturer shall provide at least one personnel door complete with sill, for each 80 linear feet of hangar door opening as a safety requirement. Doors shall be $1\frac{3}{4}$ inches thick swing or slide type industrial steel door and shall not be less than 3 feet in width by 7 feet in height and have provisions for glazing the upper portion.

5.5.1 Swing Doors.—Shall have suitably sized closers, standard hinges, and a lockset designed to lock the door securely by key from the outside and be operable by a lever, thumb turn or other suitable device not requiring a key, from the inside.

5.5.2 Slide Doors.—Shall be top-hung, gravity closing with anti-friction bearing trolleys and have a suitable locking arrangement as described in paragraph 5.5.1. Bottom-supported doors are equally acceptable.

5.5.3 Electrical Interlock.—Each personnel door shall be provided with an electrical interlock switch to prevent motor operation of the group in which it is located when the personnel door is open.

5.6 Truck doors.—Truck doors are not recommended but can be included when required in the individual job specifications.

5.7 Hardware.—Hardware shall be of a suitable design for use on hangar doors. The door manufacturer shall provide top guide rollers, bottom rollers, tractor pulls, track cleaners, and toe guards as part of the finished door.

5.7.1 Top Guide Rollers.—Except in the case of a cantilever-roof type hangar, each leaf shall be provided with stationary top guide roller assemblies. Top guide rollers shall be of the horizontal type with either a single or double wheel. Rollers shall be made of either steel or malleable iron, and shall be of a suitable size for satisfactory performance under the designated load conditions. Rollers shall be provided with adequate bearings (see Fig. 1).

5.7.1.1 In cases where doors shall be used in a cantilever-roof type hangar, top roller assemblies shall be designed to move up and down within the specified deflection of the roof in the vicinity of the door opening. Roller assemblies shall be designed to allow easy removal through the top of the guide system (see Appendix B). One type of acceptable top guide arrangement is shown in Figure 2. The top guide roller assemblies are designed with both horizontal and vertical rollers built into a frame which is connected in such a manner as to transmit the specified loads from the door to the hangar structure.

5.7.2 Bottom Rollers.—Bottom rollers shall be made of either cast steel or welded pressed steel having a minimum tread diameter in accordance with Table 1. Vertically adjustable rollers shall be provided where the height-to-width ratio of the door leaf exceeds 3. Rollers shall be designed to permit removal without taking the door leaf from its position on the rail.

TABLE 1.—Minimum roller sizes

Tread diameter of roller ¹	A.S.C.E. or A.R.E.A. rail size ²	Area of door leaf
<i>Inches</i>	<i>Weight in pounds per yard</i>	<i>Square feet</i>
9	16	up to 275
12	20	275 to 400
18	40	400 to 1500
24	60	Over 1500

¹ The above table applies to hangar doors of standard construction. On special doors having unusually heavy wheel loads, wheel size shall be determined by the actual wheel loading.

² Available from American Society of Civil Engineers, 33 West 39th St., New York 18, N.Y. (or American Railway Engineering Association).

5.7.2.1 Cast-Steel Rollers.—Cast-steel rollers shall be made of high-strength steel castings meeting or exceeding the minimum requirements as given in ASTM Designation A148-60, Standard Specifications for High-Strength Steel Castings for Structural Purposes, for Grade 80-40.⁶ For large doors or special applications where higher mechanical stresses are required for cast steel rollers than specified by Grade 80-40, such grade shall be furnished as required in the individual job specifications; or when a specific hardness of the rim is required, the cast-steel rollers shall be furnished to a Brinell hardness range as required in the individual job specifications.

5.7.2.2 Welded Pressed-Steel Rollers.—Welded pressed-steel rollers shall be constructed by using pressure-formed discs, heavy-walled tubing for hubs, and rolled rims, all of which shall be continuously arc welded. The material used shall, in all cases, meet or exceed the minimum requirements given in the latest edition of ASTM Designation A7, Specification for Steel for Bridges and Buildings.⁶

5.7.2.3 Treads.—Treads shall be machined concentric with bearing seats. The horizontal clearance between wheel and rail shall be not more than $\frac{1}{8}$ inch at the bottom nor more than $\frac{1}{4}$ inch at the edge of the flange. Bearing seats shall be accurately machined for a press fit to meet bearing manufacturer's requirements.

5.7.2.4 Bearings.—Bearings shall be either ball- or roller-type, arranged so that both the vertical loads and the horizontal wind loads can only be transmitted from the leaf to the wheels through the bearings. Bearings shall be provided with seals to retain the grease and prevent the entrance of dirt, and shall be equipped with high pressure grease fittings.

5.7.2.5 Alternate Design of Bottom Rollers.—Other designs of bottom rollers may be used providing all the requirements in paragraphs 5.7.2.3 and 5.7.2.4 are met.

5.7.3 Locking Devices.—The hangar door shall not be equipped with locking devices, except as specified for personnel doors in paragraphs 5.5.1 and 5.5.2.

5.7.4 Tractor Pulls.—Tractor pulls shall be provided so that the leaves can be towed by a tractor or other suitable equipment in the event of power failure.

5.7.5 Track Cleaners.—A suitable device shall be provided to clear debris from the rail head and wheel flange grooves as the leaf is moved.

⁶ Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia 3, Pa.

5.7.6 **Toe Guards.**—An adjustable full length flexible toe guard reaching to the floor shall be attached to the interior bottom edge of each leaf.

5.8 **Cable System.**—The minimum size for the cable which interconnects the leaves shall be $\frac{3}{8}$ inch, and the cables shall be of the independent wire rope center type. Sheaves over which the cables pass shall have a pitch diameter of at least 24 cable diameters, and shall have either ball- or roller-type bearings of a sufficient capacity for the operating loads. Grease fittings shall be provided for the sheave bearings.

6. DOOR OPERATION

6.1 **Operating Unit.**—Operation of the leaves shall be by either a traction drive or a fixed chain drive. Either drive system shall be designed to move the lead leaf at a recommended speed of 60 feet per minute at zero wind load conditions, and shall be operable up to and including a maximum wind load of 8 pounds per square foot. The operating unit shall consist of either a separate motor and gear reducer or a gearhead motor, high speed shaft brake (see exception under Par. 6.2.2) and necessary roller chains and sprockets. The system shall be provided with adequate overload protection for the drive unit by use of a torque limiting device. The system shall also be provided with a means for emergency conversion to tractor towing operation with electrical interlocks to protect both equipment and operating personnel. The motor shall be a single speed, squirrel cage type of sufficient size to operate the leaves under zero wind load conditions at not more than 75 percent of the rated capacity. The gear reduction unit shall allow a reversal of effort through the gears without damage to the unit. The operating mechanism shall be covered on the interior of the leaf by a removable cover plate. In cases where totally enclosed motors are used, wire mesh or expanded metal covers are acceptable.

6.1.1 **Traction Drive.**—The operating unit shall be mounted on the lead leaf of the group and shall drive one or more wheels of the power leaf. All leaves, interconnected by the specified cable system, shall start to move at the same time and arrive at their fully opened or closed position simultaneously. The necessary cables, cable sheaves and housings, pick-ups, and miscellaneous hardware shall be furnished for the cable system specified.

6.1.2 **Fixed Chain Drive.**—The operating unit shall be mounted on a fixed support at the jamb or on any leaf of the group and shall drive against a fixed chain attached to an adjacent leaf or wall. All leaves, interconnected by the specified cable system, shall start to move at the same time and arrive at their fully opened or closed position simultaneously. The necessary cable, cable sheaves and housings, pick-ups, and miscellaneous hardware shall be furnished for the cable system specified.

6.2 **Braking System.**—The braking system shall be designed to insure stoppage of the leaves, under normal dry conditions, within the safety edge overtravel limit. The brake system shall be either the electro-mechanical spring, hydraulic or pneumatic type. A hand release shall be provided to release the brake when it becomes necessary to tow the leaves with a tractor. The brake shall also be provided

with an interlock switch to prevent the motor from starting when the hand release is used.

6.2.1 Group of Leaves under 3,000 square feet.—Each group of leaves under 3,000 square feet in area shall have a high speed shaft brake operating through the motor drive system.

6.2.2 Group of Leaves over 3,000 square feet.—Each group of leaves over 3,000 square feet in area shall have a braking system operating on either the wheel or rail, which shall be in addition to the high speed shaft brake operating through the motor drive system. Under the condition of this paragraph, and when a fluid coupling is used, the high speed shaft brake required under paragraph 6.1 is optional.

6.3 Electrical Equipment and Control.—The door manufacturers shall furnish each group with the proper electrical equipment and controls, built in accordance with the latest NEMA⁷ Standards. All equipment, control circuits, and safety edge circuits shall be installed in accordance with the National Electrical Code, Standard No. 70⁸ and requirements of other authority having jurisdiction and where located 18 inches or less above the floor shall be explosion-proof.

6.3.1 Starters.—The magnetic reversing starters shall be factory wired with overload and undervoltage protection, equipped with mechanical and electrical interlocks and with transformers for the control and safety edge circuits all enclosed in a hasp-equipped general purpose NEMA I enclosure with a wiring diagram placed on the inside of the cover.

6.3.2 Push Buttons.—Each group shall have a 2-element push button station marked "OPEN" and "CLOSE", near the leading edge of the lead leaf. Each element shall have a constant pressure mushroom head, so that removing pressure from the button shall stop the movement of the group. All interior push buttons shall be in general purpose NEMA I enclosures. All exterior push buttons shall be in water tight NEMA IV enclosures.

6.3.3 Limit Switches.—Limit switches shall be provided to stop the travel of the leaves in their fully opened or fully closed position. The limit switches shall be positive acting snap action type with actuating cams designed with sufficient overtravel to permit the group to come to a complete stop without overtraveling the limit switch. The safety edges shall not be used as limit switches. The limit switches shall be mounted on the same leaf which carries the operator with actuating cams mounted on the top guides or overhead.

6.4 Safety Edge.—The leading edge of each group of leaves shall be provided with safety edges from 1 inch above the floor to the top of the door leaf. For leaves 8 inches thick or less, a single run of safety edge shall be furnished. For leaves over 8 inches thick, a double run of safety edge shall be furnished properly spaced to provide the maximum degree of safety in stopping the group. The safety edges shall be designed to provide a minimum of 3½ inches of overtravel after actuation until solid resistance is met. Actuation of the safety edge shall stop the closing movement of the door leaves. Safety edges may be either electric or pneumatic types.

⁷ Available from National Electrical Manufacturers Assn., 155 E. 44th Street, New York 17, N.Y.

⁸ Available from National Fire Protection Assn., 60 Battery March Street, Boston 10, Mass.

6.4.1 Electrical Safety Edges.—The lower portion of the safety edges to a height of approximately 5 feet shall be made independently removable for convenience in servicing or repair. The remainder of the edge may be in one piece. The safety edges shall be connected in series with the necessary relays and resist to make the system complete. The service shall not be more than 24 volts (nominal) and the circuit shall be normally energized so that the malfunction of any of the component parts will make the door inoperative.

6.4.2 Pneumatic Safety Edges.—Pneumatic safety edges shall operate by means of displaced air actuating suitable air pressure switches. A minimum of one air pressure switch shall be provided for each 20 feet of vertical edge. The electrical service to the pressure switch shall not exceed nominal 110 volts, and the circuit shall be normally energized so that malfunction of any of the component parts will make the door inoperative. Actuation of the pressure switches shall lock out the motor control until reset. The reset device shall be located beyond arms reach of affected control station.

6.5 Warning Device.—An audible signal shall be provided and shall operate when the push button is actuated for movement of the group in either direction. The device may be either electrically or mechanically activated. Locations shall be as follows:

a) **Traction Drive System.**

- 1) On power leaf, or
- 2) On wall at jamb.

b) **Fixed Chain Operator.**

- 1) On wall at jamb.

7. INSTALLATION

7.1 Doors and Accessories.—All leaves and accessories shall be installed in a thoroughly workmanlike manner. All openings and other accessories shall be completely prepared in advance of the actual door installation by the proper contractor in accordance with the approved shop and installation drawings (see Par. 4.1). Doors shall be installed in strict accordance with the directions of the hangar door manufacturer. No doors shall be installed until the hangar roof has been completed and the adjustment of the door guides completed by the structural steel contractor, in accordance with approved tolerances as given in Appendix "A".

8. CERTIFICATION

8.1 In order to assure the purchaser that the design, quality, and workmanship are as specified herein, producers may individually or in concert with their trade association, issue guarantees or mark each door, leaf, or part thereof by a stamp, or label as conforming to this standard. The following wording is recommended:

This Full Group Power-Operated Horizontal Sliding Type Aircraft Hangar Door complies with all of the requirements of Commercial Standard CS231D-63 as developed by the trade under the Commodity Standards Procedures and issued by the U.S. Department of Commerce.

(Name of Manufacturer)

APPENDIX A

The following numbered items describe work and responsibilities required to be performed by trades other than the door manufacturer and it is recommended that this information be closely followed:

1. **Top Guide and Bottom Rail Tolerances.**—In order to assure proper operation of the sliding door leaves, it is recommended that the installation of bottom rails be done only after the top guide system is in place. Top guides and bottom rails shall be furnished and installed to the following tolerances:

(a) **Top Guides and Supports.**

Vertical: Nominal architectural elevation to be held within plus or minus $\frac{1}{4}$ inch.

Lateral: Nominal center to center dimensions to be held within plus or minus $\frac{1}{8}$ inch with variation from nominal at no greater rate than $\frac{1}{8}$ inch in 20 feet. Joints of head guides are not required to be welded, but guides must be shimmed or ground so that adjoining guide surfaces are not out of line more than $\frac{1}{8}$ inch. All head guide tolerances are to be met after dead load is imposed upon the building frame.

(b) **Bottom Rails and Rail Ties.**

Vertical: Rails to be set to grade within plus or minus $\frac{1}{4}$ inch with variations from grade at no greater rate than $\frac{1}{8}$ inch in 20 feet.

Lateral: The nominal design relationship between top guides and bottom rails must be maintained. Center to center dimension of bottom rails shall be held within plus or minus $\frac{1}{8}$ inch with variation from nominal at no greater rate than $\frac{1}{8}$ inch in 20 feet. All rail joints shall either be welded and ground smooth or splice plates installed in accordance with American Society of Civil Engineers' Standards.*

(c) **End of Travel Bumpers.**

Bumpers shall be located at the end of door travel to provide for emergency stopping of doors. The dimensions and location shall be in accordance with approved drawings or the door manufacturer's recommendations.

2. **Glazing.**—All glass to be furnished and installed in accordance with standard practice.

3. **Field Paint.**—All field paint and painting to be in accordance with specified requirements and shall also include painting of bolt heads and nuts, field welds, and touch-up of abrasions in the shop coat. Painters shall exercise care and be specifically cautioned not to paint operating parts, mechanisms or limit switches. Field paint requirements should be modified to take into consideration atmospheric conditions and geographic location of the installation.

* Available from American Society of Civil Engineers, 33 W. 39th Street, New York 18, N.Y.

4. **Locks.**—If master-keyed lock cylinders are desired in personnel doors, they shall be included in the building hardware specifications. Any padlocks or special locks for electrical control panels shall also be included in the building hardware specifications.

5. **Metallic Head Weather Stripping Material.**—Metallic head weather stripping material for doors to be used in cantilever-roof type hangars must be designed and fabricated to accommodate the total deflection of the roof in the vicinity of the opening. Such weather stripping material shall be designed to fasten to the building and the material shall be galvanized steel of sufficient thickness to adequately withstand the specified wind loads without permanent deformation. It is anticipated that the material will be furnished and installed by the same trade that furnishes the top guide system, so all preparation for fasteners can be done at the fabrication shop. However, to minimize possibility of damage to the weather stripping material, it is recommended that its installation be done after the doors are in their final position on the rails.

6. **Preparation for Weather Stripping Material.**—Where weather stripping material attaches to building jambs, soffits, etc., the preparation and installation of mountings, holes in building members, and other provisions for attachment are to be in strict accordance with the door manufacturer's drawings.

7. **Electrical Wiring and Source of Power.**—All conduit, wire, junction boxes, trolley ducts, flexible multi-conductor cables, accessories, and wiring to and between all electrical equipment on or for the doors shall be installed in accordance with door manufacturer's diagram. Where electric power is not available at the site of the installation, the buyer or his agent shall make provision to have a temporary source of electrical power supplied as is deemed necessary by the door manufacturer for the proper installation of doors.

APPENDIX B

The following numbered items are design features which are intended to guide the architect-engineer in the initial building layout work:

1. **Clearance Between Leaves.**—Under certain conditions it is possible for the leaf design thickness to be insufficient to accommodate the operator. Clearance between leaves in this case shall provide for the overhang of operator components. In general, 15 inches are required for operator space.

2. **Access to Rollers.**—Provision shall be made to facilitate installation, maintenance, and replacement of top rollers.

3. **Clearance for Operator Unit.**—Due to the possibility of the operator unit extending beyond the limits of the thickness of the leaf, due consideration must be given in the design of the door pocket width to allow sufficient clearance from the farthest projection of the operator unit to the face of the pocket framing. A minimum of 18 inches should be allowed from the center line of the power leaf rail to the farthest projection on the interior wall of the door pocket.

4. **Tail Doors.**—Tail doors can be provided to increase the height of opening for a limited width at the center of the opening, to allow

access to a greater range of aircraft. For additional information, refer to Commercial Standards for:

Vertical Lift Doors
Turn-over Doors
Unbraced-Canopy Doors

5. **Sheave Clearance.**—A minimum clearance of 4 inches shall be maintained between the extreme faces of adjacent leaves in the vicinity of the interconnecting cables to allow sufficient space for the cable sheaves and cable pick-ups.

6. **Clearance for Weather Stripping Material.**—Clearance between metal parts on vertical edges of leaves, and between leaves and jambs, which are weather stripped, shall not be less than 4 inches.

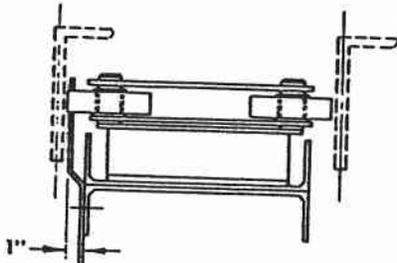
7. **Pocket Depth Clearance.**—Pocket depth to be equal to the length of the longest door leaf, plus a minimum of 3 feet to allow adequate clearance for the cable sheave brackets extending beyond the trailing edge of the leaves.

8. **Rail Drains.**—Drainage should be provided for the full length of the bottom rails. In cold areas it may be desirable to provide defrosting equipment below the rails.

APPENDIX C

The following procedures are recommended for inspection and testing of the installed door:

Inspection of the hangar door should be made by the purchaser or his agent immediately after installation, at which time the door manufacturer or his representative will perform a complete operating test. Any defects disclosed by the test are to be corrected by the door manufacturer and the installation delivered in an acceptable operable condition. After such inspections and tests, and with the doors in proper operating condition, a separate written acceptance of the installation is usually given the door manufacturer by the purchaser and/or owner or his representative.



**WEATHERING NOT REQUIRED
UNLESS SPACE EXCEEDS 1"**

FIGURE 1

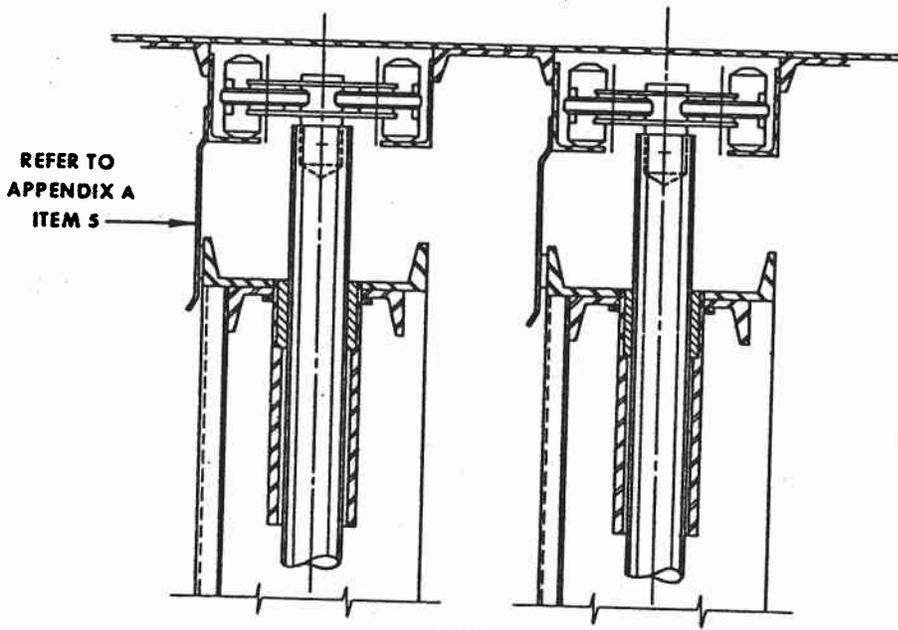


FIGURE 2

ACCEPTABLE TOP ROLLER ARRANGEMENTS

HISTORY OF PROJECT

In March 1958, the Hangar and Industrial Door Technical Council requested the cooperation of the Commodity Standards Division in establishing a series of Commercial Standards for hangar and industrial doors. This standard is the 4th in the series.

NOTE: The following is a list of Commercial Standards for other types of hangar and industrial doors which have been proposed by The Hangar and Industrial Door Technical Council:

CS231A-60, Aircraft Hangar Doors of the Manually Operated, Horizontal Sliding Type.

CS231B-61, Aircraft Hangar Doors of the Individually Power-Operated, Horizontal Sliding Type.

CS231C-63, Aircraft Hangar Doors of the Partial Group, Power-Operated, Horizontal Sliding Type.

CS231E-63, Aircraft Hangar Doors of the Power-Operated, Unbraced-Canopy Type (Steel Frame).

Proposed Commercial Standard for Industrial Doors of the Mechanically and Power-Operated, Vertical Lift Type.

Proposed Commercial Standard for Industrial Doors of the Two-Leaf Turnover Type.

Information on these standards may be obtained by writing the Commodity Standards Division, U.S. Department of Commerce, Washington 25, D.C.

The Council, through its Technical Committee, prepared a draft, which was circulated to representative groups of manufacturers, architects, airports, and municipalities for preliminary comment and approval. From suggestions offered, the draft was modified to coincide with the consensus of opinion expressed and was reviewed by the Federal Aviation Agency and the National Bureau of Standards. Copies were then circulated to the industry for written acceptance, and through trade endorsement was adopted and established as a voluntary standard of practice becoming effective April 15, 1963.

Project Manager: Edward J. McCamley, Commodity Standards Division, Office of Technical Services, U.S. Department of Commerce.

Technical Advisers: Stanley Dube, Airport Engineering Branch, Airports Services, Federal Aviation Agency; Stephen A. Cannistra, Installation & Materiel Service, Federal Aviation Agency.

STANDING COMMITTEE

The following individuals comprise the membership of the standing Committee, which is to review, prior to circulation for acceptance, revisions proposed to keep the standard abreast of progress. Comment concerning the standard and suggestions for revision may be addressed to any member of the committee or to the Commodity Standards Division, Office of Technical Services, U.S. Department of Commerce, which acts as secretary for the committee.

A. E. Wetter, Byrne Doors, Inc., 1603 E. Nine Mile Rd., Ferndale 20, Michigan (Chairman)

C. J. Erny, The Peelle Co., 47 Stewart Ave., Brooklyn 37, N.Y.

Arthur Kohn, Fleming Steel Co., New Castle, Pa.

W. R. Yokel, International Steel Co., Hangar & Industrial Door Div., 1321 Edgar St., Evansville 7, Indiana

Edward E. Ingraham, Manager, LaGuardia Airport, Box 577, Flushing 71, N.Y., Representative from the American Association of Airport Executives

V. Neisch, American Airlines, 100 Park Avenue, New York, N.Y.

D. P. Denitto, Roberts and Schaefer Co., 254 W. 54th St., New York, N.Y.

Robert E. Linton, Albert Kahn Associated Architects and Engineers, Inc., New Center Bldg., Detroit 2, Mich.

ACCEPTORS

The manufacturers, distributors, users and others listed below have individually indicated in writing their acceptance of this Commercial Standard prior to its publication. The acceptances indicate an intention to utilize the standard as far as practicable, but reserve the right to depart from it as may be deemed desirable. The list is published to show the extent of recorded public support for the standard and should not be construed as indicating that all products made by the acceptors actually comply with its requirements.

Products that meet all requirements of the standard may be identified as such by a certificate, grade mark, or label. Purchasers are encouraged to require such specific representations of compliance, which may be given by the manufacturer whether or not he is an acceptor.

ASSOCIATIONS

(General Support)

American Institute of Architects, Washington, D.C.

FIRMS AND OTHER INTERESTS

Baumer, Herbert (Architect), Columbus, Ohio
Byrne Doors, Inc., Detroit, Mich.

Camlet, J. Thomas (Architect & Engineer),
Garfield, N.J.

Capitol Steel & Iron Co., Oklahoma City,
Okla.

Central Airlines, Inc., Fort Worth, Tex.
Conrad & Cummings (Associated Architects),
Binghamton, N.Y.

Dresser Ideco Co., Columbus, Ohio

Erwin-Newman Co., Houston, Tex.

Fleming Steel Co., New Castle, Pa.

Hardy Doors, Inc., Detroit, Mich.
Hartley Boiler Works, Inc., Montgomery,
Ala.

International Steel Co., Evansville, Ind.

McPherson Co. (Engineers-Architects),
Greenville, S.C. (General Support)

Miller, Miller & Associates (Architects),
Terre Haute, Ind.

Mohawk Airlines, Inc., Utica, N.Y.

Northeast Airlines, Inc., E. Boston, Mass.

Pendleton Municipal Airport, Pendleton,
Oreg.

St. Joseph County Airport, South Bend, Ind.
Southern Air Transport, Inc., Miami, Fla.
Stoetzel, Ralph, Inc. (Architects), Chicago,
Ill.

Trans World Airlines, Inc., Kansas City, Mo.

Virginia, University of, Charlottesville, Va.

U.S. GOVERNMENT

Army, Dept. of the, Office of Chief of Engineers,
Washington, D.C.

GSA, Standardization Div., Federal Supply
Service, Washington, D.C.

Health, Education and Welfare, Dept. of
(General Support), Washington, D.C.

ACCEPTANCE OF COMMERCIAL STANDARD

CS231D-63 Aircraft Hangar Doors of the Full Group, Power-Operated, Horizontal Sliding Type (Steel Frame)

If acceptance has not previously been filed, this sheet properly filled in, signed, and returned will provide for the recording of your organization as an acceptor of this Commercial Standard.

Date _____

Commodity Standards Division
Office of Technical Services
U. S. Department of Commerce
Washington 25, D. C.

Gentlemen:

We believe that this Commercial Standard constitutes a useful standard of practice, and we individually plan to utilize it as far as practicable in the

production¹ distribution¹ purchase¹ testing¹
of this commodity.

We reserve the right to depart from the standard as we deem advisable.

We understand, of course, that only those articles which actually comply with the standard in all respects can be identified or labeled as conforming thereto.

Signature of authorized officer _____
(In ink)

(Kindly typewrite or print the following lines)

Name and title of above officer _____

Organization _____

Street address _____
(Fill in exactly as it should be listed)

City, zone, and State _____

¹UnderSCORE the applicable words. Please see that separate acceptances are filed for all subsidiary companies and affiliates which should be listed separately as acceptors. In the case of related interest, trade associations, trade papers, etc., desiring to record their general support, the words "General support" should be added after the signature.

(Cut on this line)