

UNIFIED FACILITIES CRITERIA (UFC)

BUILDERS HARDWARE



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BUILDERS HARDWARE

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U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location

This UFC supersedes TM 5-805-8, dated 20 January 1992. The format of this UFC does not conform to UFC 1-300-01; however, the format will be adjusted to conform at the next revision. The body of this UFC is the previous TM 5-805-8, dated 20 January 1992.

FOREWORD

v\

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with [USD\(AT&L\) Memorandum](#) dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: [Criteria Change Request \(CCR\)](#). The form is also accessible from the Internet sites listed below.

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- Whole Building Design Guide web site <http://dod.wbdg.org/>.

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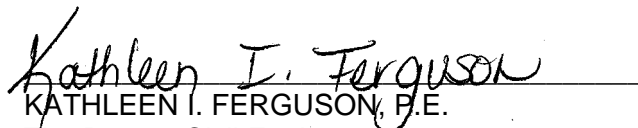
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TECHNICAL MANUAL

BUILDERS' HARDWARE

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HEADQUARTERS, DEPARTMENT OF THE ARMY

JANUARY 1992

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BUILDERS' HARDWARE

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*This manual supersedes TM 5-805-8, dated 15 July 1982.

BUILDERS' HARDWARE

1. Purpose

This manual provides criteria and guidance for the selection of builders' hardware systems for military construction.

2. Scope

This manual provides guidance applicable to architectural doors and frames for new construction, to include complex applications such as institutional and medical facilities. Criteria is established for the qualified designer to utilize in the selection of hardware systems which will satisfy functional and operational requirements of the facility to include life safety, security, and maintainability.

3. References

Appendix A contains a list of references used in this manual.

4. General

Builders' hardware definitions, design configurations, operations, and material selections will conform to those developed by the Builders' Hardware Manufacturers Association (BEMA), Door and Hardware Institute (DEI), and American National Standards Institute (ANSI). Refer to Door and Hardware Institute (DEI) Basic Architectural Hardware for discussion on hands of door, location of hardware devices, finishes, and glossary of hardware items. Consideration of the handicapped must be provided in certain buildings which will be accessible to the public or in which employment opportunities for handicapped persons may exist. Guidance for exclusions to accessibility to the handicapped may be obtained in the Uniform Federal Accessibility Standards.

5. Hardware reinforcement

Metal reinforcing is used in metal frames and metal doors. Factory drilling and tapping is required for all items of hardware that mortise into metal doors and/or metal frames, such as butts, deadlocks, lockets, mortised panic hardware, floor checks and pivots, concealed closer, concealed holders, and flush bolts. Field drilling and tapping metal doors and metal frames is normally required for surface applied door closer, panic bolts, door holders, and surface bolts. To use standard reinforcement, template hardware is required for metal and wood doors in metal frames.

6. Hinges

Hinges will conform to BEMA A156.1 and A156.7, as applicable. Fire door hinges must be in accordance with NFPA 80. Hinge material for doors other than fire doors will be wrought brass or bronze, stainless steel, or wrought steel. Hinges will have loose pins, except that hospital tip hinges will have nonremovable pins. Hinges with nonremovable pins will be used only on reverse bevel doors that must be locked and on doors swinging into confinement areas. Hinges on exterior doors will have pins with nonremovable set screw features. For outswinging exterior doors, standard weight wrought steel hinges will normally be used, except where corrosion is a problem, wrought brass, bronze, or stainless steel may be considered. Brass or bronze will not be used on fire doors. The material of the door and frame will be determined before a correct hinge selection can be made. The full mortise (butt) hinge will be used on wood or hollow metal doors and wood, hollow metal, or channel iron frames. Half mortise hinges will be used on wood or hollow metal doors and channel iron frames. Full surface hinges will be used on mineral core or hollow metal doors and channel iron frames. Half surface hinges will be used on hollow core wood or mineral core wood doors and hollow metal frames. Other options include swing-clear hinges where it is necessary to keep door opening completely clear when door is opened 90 to 95 degrees, or wide-throw hinges where necessary to keep door leaf clear of wall, casings, jambs, or reveals. The number of knuckles in a hinge, usually five knuckles, is often the manufacture's choice. Two- and three-knuckle designs are available. As an example, doors with a three-knuckle hinge are easier to lift from the hinge, should that feature be needed. A two-knuckle design hinge may be used in special design or to enhance appearance if needed in a specific location.

a. Grades. Hinges will conform to BEMA A156.1, grade 3 with the following exceptions: Grade 2 hinges will be used on doors with an overhead closer and on doors subject to high frequency use; grade 1 hinges will be used on heavy doors subject to unusual stress or very high frequency use.

b. Non-Removable Pins. The type number for Selected hinges will be followed by "NRP" (nonremovable pins).

c. Swaging. Special swaging should be considered for hinges on exterior doors and in other locations where appearance is important. Standard selection will be both leafs *swaged*- Other options are: not swaged, one leaf swaged, or one leaf swaged flat.

d. Bearings. Ball bearing, nylon, or oil impregnated metal bearing hinges will be specified for grades 1 and 2

hinges, doors equipped with an overhead door closing device, and for unusually heavy doors such as lead-lined doors. High frequency doors will have extra heavy four bearing hinges. Doors with closer will have bearing hinges, not plain bearings. Plain bearing hinges will be specified in all other cases.

e. Number. The number of hinges are specified by the size of door. Two hinges will be used for doors up to 5 feet high and three hinges will be used for doors from 5 feet to 7 feet 6 inches. Doors of greater height will have an additional hinge for each additional 2-1/2 feet or fraction thereof in height. Lead-lined doors 3 feet and larger should use pivots instead of hinges.

f. Size. Hinge size (length of pin exclusive of tips) will vary with the door thickness and will be sized based on the minimum dimensions specified in DEI Basic Architectural Hardware.

g. Fastenings. Mountings will be as recommended by the manufacturers. Screws and fasteners will come with the hardware products. Fasteners exposed to the weather will be brass, bronze, or stainless steel. Brass or bronze fasteners will not be used on fire doors. Tamperproof type or through bolts will be selected for surface mounted hinges.

7. Lockets, latchsets, and deadlocks

To the maximum extent possible, lockets, latchsets, and deadlocks will be the products of a single manufacturer. To insure that the proposed locks and latches are in compliance with the BHMA standards under which the items are specified, certificates of compliance from the product manufacturers are required. In lieu of certificates, a statement indicating that the proposed hardware items appear in the current applicable BHMA Directory of Certified Locks and Latches is acceptable. Generally, mortise locks together with deadbolts are the most secure hardware sets as compared to bored lockets with deadbolts. Security deadbolts will have high security steel collars to guard the cylinders. Lockets will be selected to have roses, escutcheons, knobs, levers, turns, and cylinder guards to cover all door preparation openings. Cylinders will be designed for six or seven pins with paracentric keyway. Normally, the six-pin cylinder will be used in general purpose construction and the seven-pin cylinder will be used primarily for more complicated keying systems. Where key changes are required for security, single-key cores will be specified. For asylum-type construction, bit key operated locks may be required in lieu of cylinder operated locks. Push/pull latches, sometimes called hospital latches, will be used on hospital patient doors and sometimes specified for labeled rest room doors. Strike for wood frames and pairs of wood doors will be furnished with wrought boxes.

a. Cylindrical or Bored-Type Lockets and Latchsets. Bored-type lockets and latchsets will normally be series 4000, grade 1, conforming to BHMA A156.2.

b. Mortise-Type Lockets and Latchsets. Mortise-type lockets and latchsets will normally be of BHMA A156.13,

series 1000, grade 1. Security grade mortise locks complying with BHMA A156.13 will be specified when extra strength is required. Lockets for door hardware in bar-racks shall conform to type F-13, mortise lock, as listed in BHMA A156.13. Mortise-type locks and latches for doors 1-3/4 inches thick and thicker will have adjustable bevel fronts or otherwise conform to the shape of the door. Lock fronts for double-acting doors must be rounded. Mortise locks will have armored fronts.

c. Deadlocks. Mortise-type deadlocks, cylinder operated, conforming to BHMA A156.5, series E 16000, may be used where appropriate. Deadbolts will have a minimum 1-inch throw.

8. Exit devices and device accessories

Exit devices will conform to BHMA A156.3. Generally, vertical locking bars will be concealed in stiles of pairs of doors. It should be noted that concealed vertical locking bars, although more aesthetically pleasing, are more difficult to adjust. Mortise lock and rim (spacing of latch to roller is critical) devices are considered the best alternative because these are easier to install and maintain properly. The rim series has the least problems, followed by mortise series, then surface vertical rod, and last the concealed vertical rod series. Rim devices can be used on pairs of doors with either fixed or removable mullions. Rim or mortise devices should be the only series used on single doors. Overlapping astragals should be used only when necessary, and not specified on pairs of doors where both leaves are equipped with vertical rod exit devices. Refer to figure 1 for examples of adjustable, fixed, and overlapping.

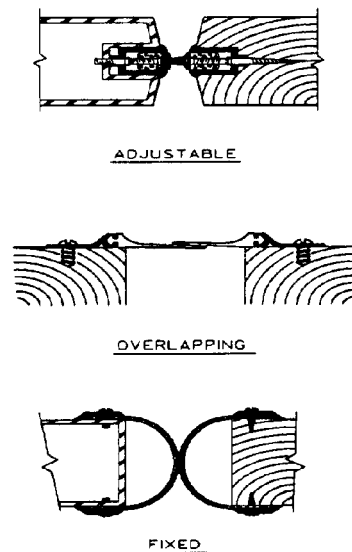


Figure 1. Astragals.

9. KEYING

a. Lock Security.

(1) *Design of Lock Cylinders.* Lock cylinders usually are designed for six or seven pins. Normally, the six-pin cylinder will be used in general-purpose construction; the seven-pin cylinder is used in more complicated master-keying Systems. Removable cores will be specified only where frequent key changes are required for security reasons.

(2) *Selection of Keying System.* Since non-masterkeyed locks offer more security against picking, it is desirable to key locks alike whenever possible rather than to master key. However, few projects, particularly of a complex nature, lend themselves to a nonmasterkeyed system. Where masterkeyed buildings are required, the form that is simplest and most practical is that in which one master key will operate all locks in the building system.

(3) *Nonmasterkeyed Cylinders.* In a nonmasterkeyed cylinder, the regular (change) key operates the cylinder by having bittings (cuts or indentations) which align the pin tumblers with the drivers (follower pins), and permit rotation of the cylinder plug to actuate the locking mechanism.

(4) *Masterkeyed Cylinders.* Lock cylinders are masterkeyed by several methods; the most common method is to split one or more pin tumblers into three sections in lieu of the standard two sections employed in the nonmasterkeyed cylinder. With the pins split into three sections, it is possible to make key bittings in such a manner that one key will raise the pins to a different position which will also allow the plug to rotate.

b. *Masterkeyed Systems.* Master keyed systems will be developed in conjunction with the Using Service to meet the operational requirements of the facility. Keying information should be obtained from the using agency in time to be inserted in the keying schedule of the contract specifications. Keyset symbols should be set up for existing work in the event some new work is to be tied in with existing systems.

(1) *New Systems at New Facilities.* Masterkeying systems at new facilities will be the standard system of the manufacturer of the lockets furnished under open competition. No restrictions will be placed on the type of system selected for installation at new facilities.

(2) *New Systems at Existing Facilities.* Where a major self-contained building or group of buildings, such as a hospital, a family housing group, or other groups of geographically isolated buildings are proposed, the masterkeying system will be established on a competitive bid basis as set forth for new systems at new facilities, except that where required for simplification of custodial operations, lockets for utilities buildings or rooms may be masterkeyed into the existing utilities masterkeying system.

(3) *Additions to Existing Systems.* Where additions to existing buildings are proposed or where new construction is being integrated into an existing building

complex having a common operational requirement, consideration may be given to integrating the added keying system with that of the existing system where so requested by the Using Service. However, proprietary keying systems must not be specified without adequate justification. The justification must provide logical reasons why a proprietary system is necessary and why the particular system named is properly the one which should be specified.

c. *Construction Master Keys.* Instead of the normal procedures for having the construction Contractor tag the keys and deliver them to the Contracting Officer, a construction master key may be specified. With this system, the Contractor will be able to use one key on all the locks during construction, but after acceptance of the work the construction master key will no longer operate the locks. When construction master keys are specified, the specification will also provide that the lock manufacturer send permanent keys directly to the Contracting Officer by registered mail or other approved means.

10. Door-closing devices

Door-closing devices shall conform to BHMA A156.4. Door closers on high frequency and exterior doors will be grade 1. Closers should not be on the outside face of the building because of the adverse effect of the weather, maintenance of the oil, and vandalism. Closers on exterior doors will have the back check feature to prevent damage to door and frame during high wind conditions. Other options available are delayed action, dead stop, fully adjustable and power adjustment plus 15%, 35% or 50%.

a. *Automatic Door Closers.* Automatic door closers are expensive to acquire and maintain. Two types of door closing devices are adequate for most general purpose construction: the surface-type closer and the checking floor hinge. In selecting the closers, consideration should be given to the wind or draft conditions, as well as the weight and construction of the door, frequency of use, and the need for a barrier-free opening. (For example, doors and closers for facilities such as chapels, schoolrooms, child development centers, and medical buildings should be selected considering that women, children, and handicapped persons frequently use such doors.)

b. *Parallel Arm Closers.* Parallel arm closers will be used when there is not enough space for a door with regular arm closer to be opened 90 degrees without the closer striking the adjacent surface. Regular arm closers should not be mounted on corner brackets. Minimum distance from floor to bottom of closer (or corner bracket) will be not less than 6 feet, 8 inches.

c. *Manual Hold-Open Mechanisms.* The hold-open feature on a door closer is designed to hold the door open within a normal range of 90 to 135 degrees, but can be used for a full opening of 180 degrees when specified. A door stop should be used when using a hold-open mechanism. The holder arm is frequently used instead of a floor door holder, particularly where the latter would

constitute a tripping hazard. Device will not be located where device will cause a tripping hazard or prevent unobstructed travel if in accordance with NFPA 101. Hold-open devices must not cause doors to be held open in violation of fire separation requirements. Hold-open devices will not be used on doors which are intended by design to be normally closed to accommodate heating, ventilating, and air conditioning system zoning.

d. Fusible Links. The fusible link holder arm feature on a door closer is designed to hold the door open and to return the door to the closed position when the link melts at a predetermined temperature. Where class A and class B fire doors are required, special care will be taken to ascertain that these units are listed or labeled by a nationally recognized independent testing laboratory. The use of a hold-open device, equipped with a fusible link, will be disallowed in a hospital occupancy on fire rated or smoke doors as they will permit smoke to enter an area and still not release until sufficient heat to fuse the link is reached (which may not occur). Mechanisms will comply with NFPA 101.

e. Size of Closers. The sizes of closers will be sized by the Contractor and *will be* shown on the Contractor's hardware schedule.

f. Floor Closers. Floor concealed closers and intermediate offset pivots may be specified for main entrance doors of monumental-type buildings, including administration, office, hospital, and similar buildings, and for other openings where concealment of a closing device is desirable or necessary to complement the architectural design.

g. Jamb Spring Hinges. Jamb spring hinges are designed for single- and double-acting operations, and are available for installation with or without a hanging strip. Hinges of this type are not used much in military construction, except for industrial-type doors through which materials are moved where automatic doors are not used. Among the more important considerations are the following:

(1) Specify hinge sizes in accordance with the manufacturer's recommendations.

(2) Hinges are not recommended for doors over 3 feet wide.

(3) Specify the third (intermediate) hinge to be installed approximately 6 inches below the bottom of the top hinge in order to obtain maximum spring efficiency.

(4) Ascertain whether the door frame is detailed with or without a hanging strip since this will determine the type of hinge required.

11. Door controls

a. Overhead-Type Door Holders. In general military construction, surface-applied overhead-type door holders may be used for outswinging exterior doors and other doors where the floor-type holder would impede traffic or interfere with furniture arrangement. In hospital construction, concealed overhead door holders may be used for doors to patients' bedrooms and for other doors re-

quired to be held at any position by friction. The overhead door holder is not designed to act as a doorstop, and therefore should not be considered for that purpose.

b. Chain Doorstops. In areas where wind forces are capable of blowing a door off its hinges, chain doorstops similar to type L02222 in BHMA A156.16, with extra-heavy shock absorber spring, chain, and attachments, may be used on exterior doors.

12. Stops and holders

a. Doorstops. Dome doorstops on bronze or stainless steel bases may be used on interior doors not required to be held open by an automatic door holder. Doorstops should be used for closer-equipped doors to prevent opening beyond the allowable limit of the closer.

b. Roller Bumpers. Where two juxtaposed doors would collide upon being opened, roller bumpers will be specified.

c. Automatic Door Holders. There are several types of automatic door holders, each designed for a specific need or condition. The following types of door holders have been found suitable for general military construction.

(1) Wall-type door holders with automatic hold-open operation are seldom used in military construction, but they are suitable in cases where floor-type door holder would cause violation of NFPA 101, where floor must be clear for traffic, or where a pedestrian tripping hazard exists.

(2) Floor-type door holders 1-01301, 1-01302, and 1-01303 in BHMA A156.16 will usually be specified; however, holder 1-01311 in BHMA A156.16 may be specified if the adjustment feature is necessary.

(3) Electromagnetic door holders may be used to permit automatic closing of fire-rated exit doors or smoke doors that are normally open. Such holders operate in conjunction with sprinkler, smoke, or fire detection systems in accordance with NFPA 101. Locations for these devices include stairway doors, doors in smoke partitions, and doors on horizontal exits. Doors are released electrically when the detection system is activated. Wiring and power will be designed in accordance with NFPA 70 and shown on electrical drawings.

13. Architectural door trim

Door protection plates, door trim, push plates, door pulls, push bars, pull bars, guard bars, and thresholds will conform to BHMA A156.6 and will be of metallic materials specified. Hospital arm pulls generally will be used on patients' bedroom doors, ward rooms, utility room doors, and doors to treatment rooms, serving kitchens, etc. Where overall design justifies their use, 8-inch by 16-inch push plates, rectangular or semicircular, may be specified. Single element push bars will be specified for screen doors, and for glazed vestibule doors where simplicity of design is desirable. Push-pull bars will be

specified for main entrance and vestibule glass doors of monumental-type buildings.

14. Protective plates

Plates will conform to BHMA A156.6 of materials listed.

a. Armor Plates. Armor plates will be specified for wood and hollow metal doors subject to damage from vehicular traffic or damage or defacement in confinement areas. Armor plates are usually located on the push side of the door.

b. Kick Plates. Kick plates will be specified for wood or hollow metal doors equipped with a door-closing device. Kick plates will be used on painted or metal doors without positive latching devices. Kick plates are located on the push side of the door.

c. Mop Plates. Mop plates will be specified on doors that are subject to frequent floor maintenance, such as in corridors, lobbies, cafeterias, kitchens, and toilet rooms, and are not equipped with armor or kick plates.

15. Auxiliary hardware

Various types of auxiliary hardware will conform to BHMA A156.16 and will be of the type specified or shown on drawings.

16. Miscellaneous

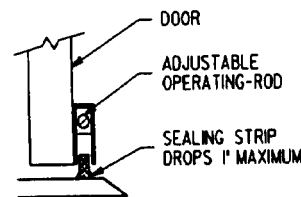
a. Automatic Door Bottoms. Automatic door bottoms are used to exclude light, air, and sound from traveling under doors in openings to light traps, air traps, darkrooms, and soundproof rooms. Door bottoms are available for surface- and mortise-type installations. Automatic door bottoms must be used on doors that are sound rated. Doors in carpet areas will use thresholds. Figure 2 shows examples of surface and concealed door bottoms.

b. Flush Pulls. Flush pulls will be specified for the pilot doors in sliding hangar doors, and for other hinged or sliding doors requiring a nonprojecting pull.

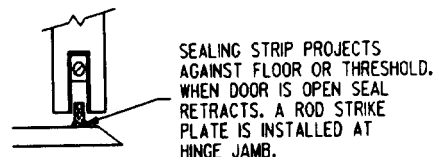
c. Light-Trap Locks. Light-trap locks are electrically operated automatic locking devices designed to prevent two or more doors connecting a corridor or room with another room from being opened simultaneously. These locks will be specified for entrance corridors to darkrooms or other areas to control the admission of light or air.

d. Pivots. Center hung or offset floor hinges should be used for heavy or extra wide exterior or interior doors when floor closer is not used.

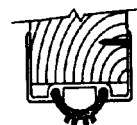
e. Padlocks. Padlocks will be of cast, forged, or extruded brass or bronze. Padlock size (dimensions of case and diameter of shackle) will be suited to specific requirements. Padlocks will be key operated. Straps, tee hinges, and hasps conforming to BHMA A156.20 will be selected to match high security padlocks.



SURFACE MOUNTED



MORTISED AUTOMATIC



DOOR BOTTOM SEAL

Figure 2. Door Bottoms.

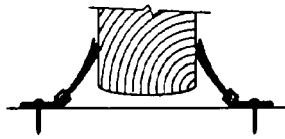
f. Door Edging. Door edging installed in conjunction with armor plate will be of the J200 series conforming to BHMA A156.6.

g. Metal Thresholds. Metal thresholds for use with weather stripping for exterior doors will be aluminum or bronze, flat-type with fluted top to provide proper door clearance, and an effective seal with specified weather stripping. Thresholds for use with floor closers will conform to BHMA A156.4, type to be specified. Latching thresholds will conform to BHMA A156.3, type 26, and be of appropriate height.

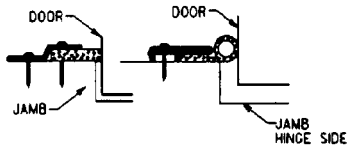
h. Seals. Seals will be used to inhibit the passage of air, sound, smoke, light, dust, and humidity. These seals must not interfere with the positive closing and latching of the door. Example of seals are shown in figure 3.

i. Rain Drip Strips. Rain drip strips will be attached to the outside of exterior doors exposed to the weather to divert the passage of water beyond the threshold. Figure 4 shows type A which goes at the top of the door and type B at the bottom of the door.

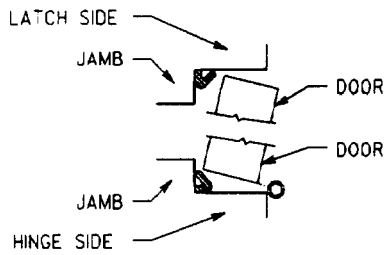
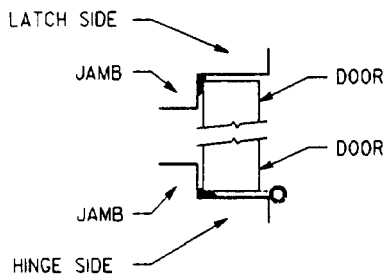
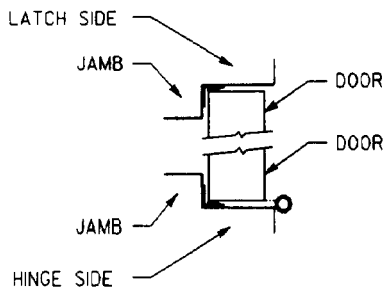
j. Gasketing. Examples of gasketing are shown in figure 5.



FOR PIVOT HUNG DOORS

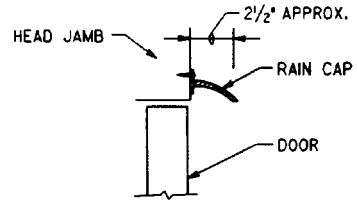


PERIMETER SEALS

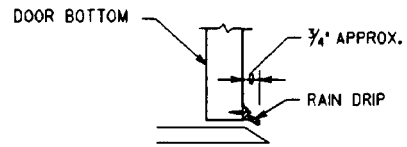


JAMB MOUNTED

Figure 3. Seals.

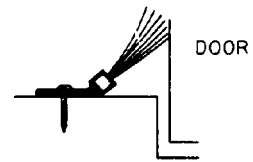


JAMB MOUNTED

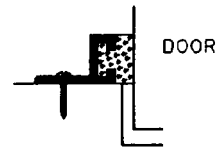


DOOR BOTTOM MOUNTED

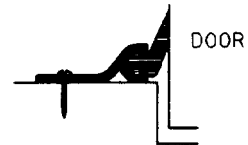
Figure 4. Rain Drip Strips.



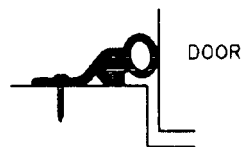
NYLON BRUSH



NEOPRENE



VINYL



VINYL

Figure 5. Gasketing.

k. *Door Sweeps.* Door sweeps shown in figure 6 make contact with a threshold when the door is closed and are generally installed on outswinging doors.

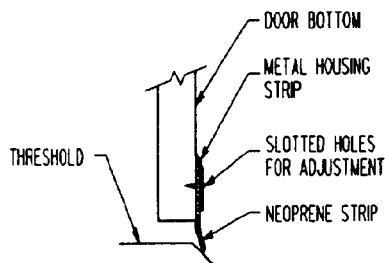


Figure 6. Door Sweeps.

17. Hardware for fire-rated doors

The term "fire-rated doors" as used in this manual refers to hinged-type fire-resistant doors bearing the label of Underwriters' Laboratories, Inc., or Factory Mutual Laboratories, as well as to nonlabeled hinged-type doors constructed and hardware-equipped in accordance with the published standards of those laboratories. Hardware includes hinges, locks, latches, flush bolts, door closers, door coordinators, fire exit bolts, and door holders of types either investigated by a nationally recognized testing inspection agency or of acceptable design and construction. For approved fire door hardware, see current Building Material Directory of Underwriters' Laboratories, Inc. Fire door assemblies must meet the test requirements of BHMA A156.1, and must be in compliance with NFPA 80 and NFPA 101.

a. *Hinges.* Only ball bearing or oil impregnated bearing steel or stainless steel hinges are acceptable for use on fire-rated doors. Type, size, weight, the number of hinges required for the several classes of doors, and the method of their attachment to door and door frame will be in accordance with the applicable requirements of NFPA 80.

b. *Lockets and Latchsets.* Lockets and latchsets will be the heavy-duty mortise or mortise-integral type, or the heavy-duty bored type. Knobs will have screwless shanks. For single doors, the latch bolt will have a minimum throw of ½ inch; for pairs of doors, a single-point lock with a ¾-inch minimum throw latch bolt will be provided on the active leaf of the pair, and an extension lever flush bolt will be provided at the top and bottom of the inactive leaf.

c. *Door Closers.* A door-closing device will be installed on each single fire door and on each leaf of a pair of active fire doors. Fusible links with a rating of 160 degrees Fahrenheit, will be provided on automatic

door closers with hold-open arms. Closers with fusible links will not be used on required fire exit doors. Door closers will be attached to the several types of fire doors in accordance with NFPA 80. The use of a hold-open device, equipped with a fusible link, will be disallowed in a hospital occupancy on fire rated or smoke doors as they will permit smoke to enter an area and still not release until sufficient heat to fuse the link is reached (which may not occur). Corner bracket will be used only where required for rehabilitation work. Mechanisms will comply with NFPA 101.

d. *Door Coordinator.* A door coordinator will be required for pairs of fire doors equipped with an overlapping astragal.

e. *Fire Exit Bolt.* Where fire exit bolts are required on fire doors, the crossbar locking or dogging feature will be omitted in order to allow positive latching of the door upon closing.

f. *Electromagnetic Door Holders.* When required to hold fire exit doors in a normally open position, electromagnetic door holders will be installed in accordance with the requirements of NFPA 101, and must have fail-safe function. Smoke detectors and magnetic holders conforming to BHMA A156.15 may be integrated with door closers and may be electromagnetic or electromechanical type smoke detectors and activators will be specified. Units will have been tested or labeled by a nationally recognized independent testing laboratory.

18. Electric hardware

This section is to provide general information on electric hardware and is not meant to supercede security requirements specified in other manuals. Electric hardware may be classified into four categories: locking, power transferring, door control, and switching devices. These devices are either fail-safe or fail-secure. Fail-safe devices allow the door to open and close (and latch) normally in the case of loss of power, and fail-secure devices cause the door to lock on key side upon loss of power. Care must be taken to weigh all factors of life safety and security, and to specify the appropriate type of electric hardware action. Electric locks will be fail-safe function. Electric strikes will be fail-safe or fail-secure. Fire doors will be fail-safe. In order to reduce maintenance, time and cost, all devices should have the same manufacturer. This limits the cost of additional service trailing and lowers the cost of parts maintenance.

a. *Electrical System Coordination.* Documents which are referenced in the selection of mechanical hardware for grade, type, and function are also applicable for selection of electrified products. In addition, NFPA 70 may also guide, restrict, or limit the application of certain products. Specifications must include power wiring and boosters if necessary to go with electric hardware. The attachment of products with voltage greater than 30 volts AC or 48 volts DC to metallic doors and frames should always be reviewed before acceptance. In no case should products whose voltage exceeds these limits be used on

nonmetallic doors and frames. In addition, in hazardous locations, products which use intrinsically safe power supplies or other means of operations, such as pneumatics should be considered. In all cases wiring must be encased in separate metallic conduit with true earth ground. Stray voltages in many facilities could produce small voltages in lock wiring which would prevent locking devices from releasing in critical situations.

b. Locking.

(1) *Electric Bolt Retraction.* This feature differs from locking in that it retracts the locking mechanism, allowing the door to be operated in a push-pull manner. This feature could also be used in conjunction with automatic door openers, providing security as well as convenience. Bolt and latch retraction is available in "deadbolt" style electric locks. Single and multipoint latch retraction is available in both accident hazard called "panic" and fire exit devices.

(2) *Locking Control.* This action is similar to standard pinned profile key action and is available in most all types of lockets, such as cylindrical, mortise, and exit devices. In each case the trim is unlocked by the application of electricity.

(3) *Electric Strikes.* Electric strikes permit the use of standard store room function lockets integrated with access control. For security purposes electric strikes are not recommended for applications which require mounting on the exterior side of the frame. Electric strike mounting locations are acceptable when used in conjunction with rim or mortise exit fire and panic devices. Labeling restrictions do not allow the use of electric strikes with fire rated vertical rod exit devices. For security reasons and the validity of testing laboratory approval, the use of vertical rod devices with electric strikes is not acceptable in those cases where compliance with NFPA 101 and NFPA 80 is required.

(4) *Magnetic Locks.* As an auxiliary locking device, the magnetic lock is suitable for high traffic access control designed to control both sides of door. Since positive latching is fail-safe on a loss of electrical power, their use as the only locking device on a label door is not acceptable.

(5) *Special Locking Arrangements.* NFPA 101 and some building codes refer to special locking by this or similar title. This type of locking combines opening features that typically would be on exit doors with a level of security which adds a delay time after detection of from 15 to 30 seconds. The use of this method is dictated by the requirements of the area to be contained, not only to protect property or information from theft but to protect lives. This could be the case in a hospital, where it might be required to prevent the wandering of patients, or in high security areas. Normally, it requires several pieces of equipment to be assembled into a system. In no case should this system be assembled which does not contain an exit device that meets both fire and exit requirements.

c. Power Transferring When electric door hardware is mounted on swinging doors, power transferring is re-

quired. One or more of the hanging devices, hinges (BHMA A156.1) or pivots (BHMA A156.4) may be replaced with a unit of similar appearance which has been modified to contain current carrying wiring. When electrical requirements dictate, special products are required to meet the higher current capabilities. Surface mounted transferring devices should not be mounted on the unsecured side of the opening or be mounted in the opening which might encounter traffic that could catch on the device.

d. Door Control. Electric door control hardware may either limit the force required to open or restrict the closing action of the door. The designer should be aware that there is a limited number of automatic door manufacturers. The selection of automatic doors will consider the safety of operation. Mats which activate doors will be discouraged. Power assist and low energy power operated doors will conform to BHMA A156.19.

(1) *Opening Assist Units.* These are door operators which for a short time, remove the back pressure of a closing device. Operators are also available as limited energy door operators designed to occasionally open doors for the physically impaired.

(2) *Restricting Closing.* This hardware can both prevent, as well as delay the closing action of a door. Doors are held in the open position for convenient operation of the area or building while meeting the self-closing requirements of fire rated doors. This feature may also be used to control the door for securing an opening from a remote location and/or for automatically containing a building under siege.

(3) *Preventing Reclosing.* These devices for a door are connected to some type of smoke, fire, or other emergency detection system. If the emergency system is actuated or there is a loss of power, the door will be self-closing as required by NFPA 80 and other local codes. At any time, the door may be manually pulled out of the hold open position, allowing the door to close. Devices which prevent closing include both those built into the door closer as well as those which attach to the wall or floor and have the strike attached to the door. Door closers may also have the smoke and heat sensors built into the closer.

(4) *Delayed Reclosing* Delayed reclosing provides physically impaired persons adequate time to pass through an opening without the hindrance of the door under the force of a door closer. These systems require a limited energy assist unit in place of a standard closer. Devices which are similar in appearance to regular closers are acceptable from an aesthetic perspective.

e. Switching Devices. These devices range from a wall mounted switch which must match the finish of the other hardware on or about the door, to a key (or card) operated switch that operates the electrified door hardware. Such products should be provided by the manufacturer of the hardware so as to match the finish as well as the compatibility of the products. Using other sources could jeopardize the successful operation of a system as well as make obtaining parts and service difficult.

19. Computerized keying

Access control consists of replacing the existing pinned profile type key for locking with a system which offers individual or grouped assignment access to an area or place of storage. Consideration must be given to each lock location to determine if fail-safe or fail-secure is needed upon loss of electric power. This limiting may be made by the issuance of an encoded device and/or a numerical code, Personal Identification Number, PIN. At the required point of entry a device is installed to enter the encoded device and/or PIN for specific or subgroup identification. If the recognition is positive, then permission to enter is granted. These Systems allowing time/day/date rejection of users as well as an audit trail of those who have gained access or have been rejected for attempted entry at non-authorized times.

a. Encode Devices. Encode devices are available in various technologies in card and key shaped products. Cards, the most universal encoded device are available in punched hole, scattered magnet, scattered wire, magnetic stripe, and proximity types. While some card types are more difficult to duplicate than others, the rule for selecting a type should be cost and availability for additions and replacements to a system. Even a duplicate card's origin can be traced in a well maintained system. Magnetic cards best meet these criteria.

b. Card Systems. Card systems maybe either hardwired, stand alone self-powered, or systems which include both types of entry points so long as both types use the same encoded card. The highest level of security will have individual card codes as well as unique PIN's.

c. Reader Mechanisms. Reader mechanisms should

be constructed of nonferrous or stainless metals. Plastic readers or keypads are not recommended for hallways or other areas which would be subject to damage from cart traffic. Plastic enclosures are not acceptable for exterior locations which are subject to vandalism.

d. Standalone Self-Powered Access Units. These lock-sets are acceptable for rooms where each room or area has less than ten individual users. These units must be adaptable to standard ANSI door preparations to conform with fire door requirements. Such a control may contain an onboard buffer to maintain history of the recent users. This provides an audit trail for analysis of recent occupation. Self-powered units may require physically going to the lock to remove or change a user's access. Reprogramming of the system should not require the disassembling of the system or lock. This type of locking should be available for as many types of locks as possible including cylindrical, mortise, or exit devices. Such devices must also be available with lever handles so as to meet the requirements for handicapped in facilities so designated.

e. Single Code or Card Locking Devices. These units are of limited value except for an area with only one user. Tracking of usage is almost impossible and therefore presents little, if any, security.

20. Finishes of hardware

Finishes will conform to table 1, with code numbers from BHMA A156.18. Exposed parts of concealed closers will have finish to match lock and door trim. Hardware for aluminum doors will be finished to match the doors.

Table 1. Specifications for Hardware Finishes.

<u>BHMA CODE</u>	<u>DESCRIPTION</u>	<u>BASE MATERIAL</u>
ALUMINUM DOOR HINGES		
626	Satin chromium plated	Brass, bronze
630	Satin Stainless steel	Stainless steel
INTERIOR DOORS AND INSWINGING EXTERIOR DOORS		
600	Primed for painting	Steel
639	Plated satin bronze, clear coated	Steel
652	Satin chromium plated	Steel
OUTSWINGING EXTERIOR DOORS		
600	Primed for painting	Steel
612	Satin bronze, clear coated	Bronze
626	Satin chromium plated	Brass, bronze

Table 1. Specifications for Hardware Finishes. - continued

<u>BHMA CODE</u>	<u>DESCRIPTION</u>	<u>BASE MATERIAL</u>
ALUMINUM DOOR LOCK AND TRIM		
626	Satin chromium plated	Brass, bronze
628	Satin aluminum, clear anodized	Aluminum
630	Satin Stainless steel	Stainless steel
MAIN ENTRANCE DOOR LOCK AND TRIM		
612	Satin bronze, clear coated	Bronze
626	Satin chromium plated	Brass, bronze
628	Satin aluminum, clear anodized	Aluminum
630	Satin stainless steel	Stainless steel
OTHER LOCK AND TRIM		
612	Satin bronze, clear coated	Bronze
626	Satin chromium plated	Brass, bronze
628	Satin aluminum, clear anodized	Aluminum
630	Satin stainless steel	Stainless steel
639	Plated satin bronze, clear coated	Steel
652	Satin chromium plated	Steel
DOOR CLOSERS		
600	Primed for painting	Steel
689	Aluminum painted	Any
690	Dark bronze painted	Any
691	Light bronze painted	Any
692	Tan painted	Any

21. Computerized key control system

This system will provide the most effective method for documenting, issuing, and controlling all keys, of all types for a given facility. The system enables one to store on the computer a complete description of all keyed items including index numbers, location of opening, lock manufacture, key number, related master keys and grand master keys, total number of existing keys, and number of keys currently on loan. This system is cost effective as compared to conventional key control systems. It will not only provide the using agency with accurate control, but also security, convenience, and flexibility.

22. Contract drawings and specifications

Drawings and specifications will include the following information, as indicated.

- a. Door identification number (drawings - floor plans and door schedule).
- b. Hardware set number (HW-1) (drawings - door schedule only; and specifications - detailed listing).
- c. Door and frame materials and construction (drawings and specifications).
- d. Swing of door (drawings - floor plan only).
- e. Door and frame sizes and design including height, width, and thickness of door, thickness of stop, and width of frame (drawings).
- f. Finish and the locations (specifications).
- g. Key set symbol (specifications).
- h. Key schedule (specifications).

APPENDIX A REFERENCES

Nongovernment Publications

Builders' Hardware Manufacturers Association (BHMA), 60 East 42nd Street, New York, New York 10017

Directory of Certified Locks and Latches (Effective thru June 1985)

A156.1 -1988	Butts and Hinges
A156.2 -1989	Locks & Lock Trim
A156.3 -1989	Exit Devices
A156.4 -1986	Door Controls - Closers
A156.5 -1984	Auxiliary Locks and Associated Products
A156.6 -1986	Architectural Door Trim
A156.7 -1988	Template Hinge Dimensions
A156.13 - 1987	Mortise Locks and Latches
A156.15 - 1986	Closer Holder Release Devices
A156.16 -1989	Auxiliary Hardware
A156.18 -1987	Materials and Finishes
A156.19 -1990	Power Assist and Low Energy Power Operated Doors
A156.20 -1989	Strap and Tee Hinges and Hasps
A156.21 - 1989	Thresholds

Door and Hardware Institute (DHI), 7711 Old Springhouse Road, McLean, Virginia 22102-3474

Basic Architectural Hardware (1985)

National Fire Protection Association (NFPA), 470 Atlantic Ave., Boston, Massachusetts 02210

70-1990	National Electrical Code
80-1990	Fire Doors and Windows
101-1988	Code for Safety to Life from Fire in Buildings and Structures

Underwriters Laboratories, Inc. (UL), 333 Pfingsten Road, Northbrook, Illinois 60062

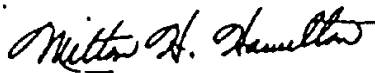
Building Materials Directory (1990)

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