MAYFLOWER SALES COMPANY, INC.

Basic Hinge Selection

General Architectural Hinge Information

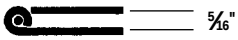
The hinges are one of the most active components of an opening combined with the lock, exit device, and closers. Hardware in general is not thought of unless it does not work properly, and the door unit will not function properly if the proper hinging device is not specified.

There are hinges that will meet all types of applications. Special care should be taken to specify the proper hinge for the necessary application. The American National Standards Institute publications pertaining to hinges (ANSI A156.1, A156.7, A156.17, and A156.18) are extremely helpful in making the correct selection of the proper hinge.

There is one easy way to remember what the hinge is called. The Full Mortise and the Full Surface are really no problem. However, the Half Mortise and the Half Surface are sometimes difficult to keep straight. You need only remember – what the hinge is called is what is done to the door. A Half Mortised hinge is mortised to the door and surface applied to the frame. A Half Surface hinge is surface applied to the door and mortised to the frame.

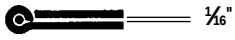
Note: Hinge information pages are courtesy of the Hager Hinge Company

Hinge not swaged — figure 1



Hinge not swaged — figure 2

Hinge swaged (standard) — figure 3



Hinge swaged (standard) — figure 4

Hinge with one leaf swaged — figure 5

One point that must be made when discussing the classifications of hinges is SWAGING. Swaging is a slight offset of the hinge leaf at the barrel. This offset permits the leaves to come closer together when the door is in the closed position. If the hinge were to be left in the natural state after the knuckle was rolled, the hinge would be referred to as a "flatback". A flatback hinge has a gap between the leaves of approximately 5/16". This would allow heat and air-conditioning to escape, not to mention the unsightly gap between the door and frame.

The standard swaging on standard weight and heavy weight full mortise hinges provides 1/16" clearance between the leaves, when the leaves are in the closed position.

Three additional features that are commonly used are: Non-removable Pin (NRP), Safety Stud (SH), and Reverse Security Stud (RSS).

Non-removable Pin

The non-removable pin (NRP) has a small set screw in the body of the barrel. This set screw is tightened down against the pin. The pin has a groove in the position where the set screw makes contact, allowing the set screw to seat. The set screw is positioned so it cannot be reached unless the door is opened. If pin removal is necessary, the set screw is merely removed and the pin tapped from the bottom in the usual manner.

Safety Stud

The safety stud (SH) 3/16" projection is another feature which places a stud on one leaf and a locking hole on the other leaf; when the door is closed, the stud is anchored into the opposite leaf. Even if the hinge pin is removed, the door is secure because the leaves are locked together.

Reverse Security Stud

The reverse security stud (RSS) 7/16" projection is a feature that has a stud projecting from the back of both leaves into the reinforcing plate of both the frame and the door. It is intended to keep the hinge locked in place from abuse of battering or trying to shear the hinge and screws. This feature is primarily used in prisons and psychiatric areas.

Note: Many hinges are available with options such as non- removable pin (NRP), safety studs, decorator tips, hospital tips swaging and more.

Non-removable pin (NRP)

Safety stud (SH)

Reverse security stud (RSS)

One important point must be made here. These features are intended as deterrents only. If someone wants to gain entry through a door badly enough, eventually they will get through.

Swing Clear

Another special feature hinge is the Swing Clear type. This is used mostly in hospitals and institutional buildings when the passage area must be the full width of the opening. One such case would be an eight foot wide corridor that requires the full opening for the passage of two beds or carts. With the use of swing clear hinges this passage can be accomplished.

The hinges are designed to swing the door completely clear of the opening when the door is opened 95 degrees. The standard way to accomplish this degree of opening is to build a pocket in the wall to accept the door. This allows the door to be concealed in the wall and not obstruct the flow of traffic.

Basic Hinge Selection

1. Determine Type of Hinge

There are several pieces of information that are needed to select the proper type of hinge:

- What is the door material (wood, stainless steel, fiberglass, or hollow metal)?
- What is the frame material (wood, stainless steel, channel iron, or hollow metal)?
- How do we determine the proper type of hinge? There are four classifications of hinges:

Full Mortise — Both leaves are mortised, one leaf to the door and one leaf to the frame.

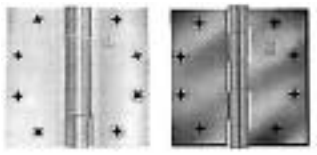
Half Mortise — One leaf is mortised to the door and the other is surface applied to the frame.

Full Surface — Both leaves are applied to the surface, one to the door and the other to the frame.

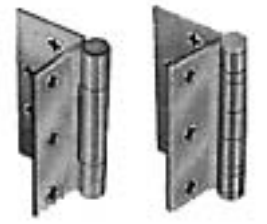
Half Surface — One leaf is mortised to the frame and the other is surface applied to the face of the door.

Determining Hinge Size

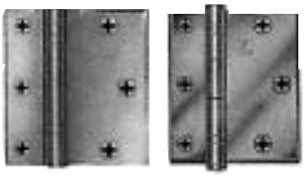
One additional point to remember: only on the Full Mortise hinges are their two dimensions, such as a $4^1/_2$" x $4^1/_2$". The first dimension indicates the height and the second dimension indicates the width when the hinge is in the open position. On all other classifications there is only one dimension, that is the height.



Full Mortise Hinge

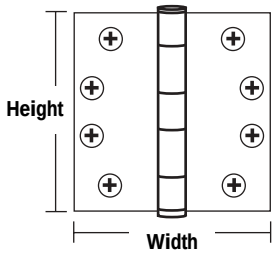


Half Mortise Hinge



Full Surface Hinge

Half Surface Hinge



Height x Width
Example: BB1279-4x4-1/2-26D

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Basic Hinge Selection

1. Determine type of Hinge

Underwriter's Laboratories does not specifically apply UL listings to hinges. Instead, their *Builder's Product Directory* refers to NFPA80 Standard for Fire Doors and Fire Windows 1995 Edition, listed below.

Builders Hardware Mortise, Surface, and Full Length Hinges, Pivots or Spring Hinges for Swinging Doors

Doors up to 60 in. in height shall be provided with two hinges and an additional hinge for each additional 30 in. of door height or fraction thereof. The distance between hinges shall be permitted to exceed 30 in.. Where spring hinges are used, at least two shall be provided.

	MAXIMUM DOOR SIZE				MINIMUM HINGE SIZE				
	WIDTH		HEIGHT		HEIGHT		THICKNESS		
DOOR RATING (HR)	ft	m	ft	m	in.	mm	in.	mm	HINGE TYPE
	FOR 1 3/4 IN. OR THICKER DOORS								
3, 1 1/2, 1, 3/4, 1/2, 1/3	4	1.22	10	3.05	4 1/2	114.3	0.180	4.57	Steel, mortise or surface
3, 1 1/2, 1, 3/4, 1/2, 1/3	4	1.22	8	2.44	4 1/2	114.3	0.134	3.40	Steel, mortise or surface
1 1/2, 3/4, 1/2, 1/3	3 1/16	0.96	8	2.44	6	152.4	0.225	5.72	Steel, olive knuckle or paumelle
3, 1 1/2, 3/4, 1/2, 1/3	4	1.22	10	3.05	4	101.6	0.225	5.72	Steel pivots (including top, bottom, and intermediate
1 1/2, 1, 3/4, 1/2, 1/3	3	0.91	5	1.52	4	101.6	0.130	3.30	Steel, mortise or surface
1 1/2, 1, 3/4, 1/2, 1/3	3	0.61	3	0.91	3	76.2	0.092	2.34	Steel, mortise or surface
3, 1 1/2, 1, 3/4, 1/2, 1/3	3	0.91	7	2.13	4 1/2	114.3	0.134	3.40	Steel, mortise or surface (labeled, self-closing, spring type)
3, 1 1/2, 1, 3/4, 1/2, 1/3	3	0.91	7	2.13	4	101.6	0.105	2.67	Steel, mortise or surface (labeled, self-closing, spring type)
	FOR 1 3/8 IN. DOORS								
3, 1 1/2, 3/4, 1/2, 1/3	3	0.91	7	2.13	3 1/2	88.9	0.123	3.12	Steel, mortise or surface
3, 1 1/2, 1, 3/4, 1/2, 1/3	2 2/3	0.81	7	2.13	3 1/2	88.9	0.105	2.67	Steel, mortise or surface (labeled, self-closing, spring type)

Notes

1. All hinges or pivots, except spring hinges, shall be of the ball bearing type. Hinges or pivots employing other antifriction bearing surfaces shall be permitted if they meet the requirements of ANSI A156.1, *Standard for Butts and Hinges.* Spring hinges shall be labeled.
2. Hinges 4 1/2 in. high and 0.180 in. thick shall be permitted for use on wide and heavy doors or doors that are subjected to heavy use or unusual stress.
3. Some manufacturers can provide fire doors with hinges of lighter weight that are not of the ball bearing type where they are part of a listed assembly, meet the test requirements of ANSI A156.1, *Standard for Butts and Hinges,* and have been tested to a minimum of 350,000 cycles.
4. Pivot sets made up of components that are smaller or of a lighter gauge than shown in this table shall be permitted to be used, provided they meet the requirements of ANSI A156.4, *Door Controls (Closers),* and are in accordance with the manufacturer's label service procedures.

2. Select the proper weight and bearing structure

Because of the large variety of door sizes and weights, hinges are placed into three groups:

Type and Example

HEAVY WEIGHT— Ball Bearing

STANDARD WEIGHT — Ball Bearing

STANDARD WEIGHT — Plain Bearing

There are two factors that determine the weight and structure of the hinge: weight of the door and frequency of use.
The weight of the door is strictly based on how much the material of the door weighs. It is also advisable to include the approximate weight of additional hardware that will be installed on the door. Table #1 represents approximate weights of most common doors and is intended to be a guide or approximation.

Example

1-3/4" White Pine door = 3.5lb./sq. ft.
3'0" x 7'0" = 21 sq. ft. **3.5 x 21 = 73.5 lbs.**

Frequency of use

The next factor is the frequency of use. How often is the door opened and closed in a given time frame? This is usually figured on a daily basis. Some general guidelines for high, medium, and low frequency are listed in Table #2.

Table #2 frequency chart recommendations apply to all average weight doors. Heavy ball bearing hinges should be used for larger doors, that is, doors having a thickness of 2" or more and over a width of 3'4".

Another note that is critical and which is often neglected; **any doors on which a closing device is used should be equipped with ball bearing hinges, irrespective of frequency of use.**

Table # 1 – Approximate Door Weights (in pounds per square foot)

DOOR THICKNESS	1 3/8"	1 3/4"	2"	2 1/4"	2 1/2"
DOOR MATERIAL					
Ash	4.5	5.3	6.0	6.8	7.5
Birch	3.8	4.3	5.0	5.6	6.3
Fir	3.0	3.5	4.0	4.5	5.0
Mahogany	4.5	5.3	6.0	6.8	7.5
Oak	6.0	7.3	8.0	9.0	10.0
White Pine	3.0	3.5	4.0	4.0	5.0
Res. Hollow Core	1.7	2.5	—	—	—
Inst. Hollow Core	—	3.2	—	—	—
Staved Core	3.3	4.2	—	5.4	—
Particle Board Core	4.0	5.0	—	—	—
Mineral Core	—	4.0	—	—	—
Acoustical Core	—	8.3	—	10.6	—
Fiberglass	—	3.8	—	—	—
Hollow Metal 18 gauge	4.3	4.6	—	—	—
Hollow Metal 16 gauge	5.4	5.8	—	—	—
Hollow Metal 15 gauge	6.2	6.5	—	—	—
Hollow Metal 14 gauge	7.0	7.3	—	—	—
Hollow Metal 13 gauge	8.3	8.7	—	—	—
Hollow Metal 12 gauge	9.9	15.5	—	—	—
Hollow Metal 11 gauge	11.2	11.6	—	—	—
Hollow Metal 10 gauge	12.8	13.0	—	—	—
1 3/4" Wood + 1/16" Lead	—	8.7	—	—	—
1 3/4" Wood + 1/8" Lead	—	12.4	—	—	—
1 3/4" Wood + 3/16" Lead	—	16.1	—	—	—
1 3/4" Wood + 1/4" Lead	—	19.8	—	—	—
1 3/4" Wood + 3/8" Lead	—	27.2	—	—	—
1 3/4" Wood + 1/2" Lead	—	34.6	—	—	—

Table # 2 – Frequency of Use

TYPE OF BUILDING	EXPECTED FREQUENCY	
HIGH FREQUENCY	**DAILY**	**YEARLY**
Large Department Store Entrance	5,000	1,825,000
Large Office Building Entrance	4,000	1,460,000
Hospital Corridor and Surgical Doors	3,000	1,095,000
School Entrance	1,250	456,250
Office Stairwell	500	182,500
MEDIUM FREQUENCY		
Hospital Consultation Rooms	100	36,500
School Corridor	100	36,500
Office Building Corridor	80	29,200
Storage Room	50	18,250
LOW FREQUENCY		
Residential Entrance	30	10,950
Residential Interior	20	7,300

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Basic Hinge Selection

3. Determine the size of hinge

In order to determine the proper size of the hinge, several bits of information will be necessary: door height, door width, door thickness, door weight, and trim dimension.
The first thing to find is the height of the hinge. Follow the examples indicated in Table #3. These are only examples.
Job situations will offer many more variables.
The next determination is the number of hinges per door leaf.
A general rule of thumb: **one hinge for every 30" of door height or fraction thereof.**

DOOR HEIGHT	NUMBER OF HINGES
Up to 60"	2 Hinges
Over 60" to 90"	3 Hinges
Over 90" to 120"	4 Hinges

Naturally, this rule does not apply on heavy doors or doors with greater than standard width. For doors with a width greater than 37" to 48", four hinges could be used for additional strength. The fourth hinge helps support the additional weight and tension applied to the frame created by the wider door width. Refer to Table #4.
There are three dimensions to know in order to determine the minimum width of the hinge: door thickness, backset, and clearance required.

When figuring the calculations for a wood door and wood frame, the door is flush with the casing or face of the frame. When figuring the calculations for a wood or metal door with a hollow metal frame, the door is inset approximately 1/8".

For doors up to 2 1/4" thick, the hinge is set back 1/4" from the back face of the door.

For doors over 2 1/4" thick, the hinge is set back 3/8" from the back face of the door.
See Table #5 for further clarification.

Once these dimensions are known, the formula can then be applied. **Take the door thickness, minus the backset, times two, plus the clearance required.** If the size hinge is not standard, then go to the next larger hinge width.

As explained before, the full mortise hinge type has two dimensions. The first size is the height and the second size is the width when the leaves are in the open position. In this configuration, it may be necessary to have the width of the hinge extended in order to clear trim or wall conditions. If the width of the hinge is greater than the height of the hinge (example: 4 1/2" x 6") this is referred to as a **Wide Throw Hinge.** This would apply only to full mortise hinges.

Table # 3 – Height of Hinge

THICKNESS OF DOOR	WIDTH OF DOOR	HEIGHT OF HINGE
1 3/8" Door	To 32"	3 1/2"
1 3/8" Door	32" to 36"	4"
1 3/4" Door	To 36"	4 1/2"*
1 3/4" Door	36" to 48"	5"*
1 3/4" Door	Over 48"	6"*
2", 2 1/4" & 2 1/2" Door	To 42"	5" Heavy Weight
2", 2 1/4" & 2 1/2" Door	Over 42"	6" Heavy Weight

*Heavy weight hinges should be specified for heavy doors and for doors which are expected to receive high frequency use.

Table # 4

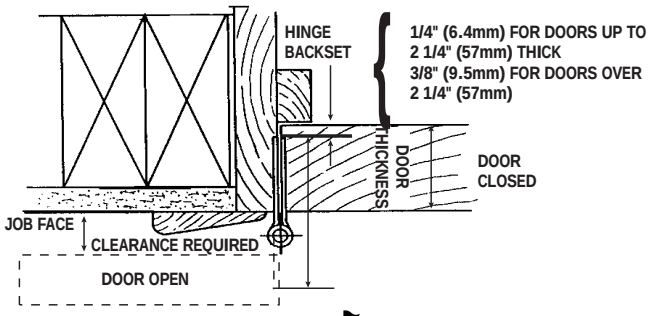
FULL MORTISE HINGE LENGTH	MAXIMUM DOOR WEIGHT	MAXIMUM DOOR WIDTH
4.5"	75	36"
4.5"	150	36"
4.5"	175	36"
5"	100	36"
5"	150	36"
5"	175	36"
6"	125	36"
6"	230	36"
6"	230	36"

MINIMUM CYCLE REQUIREMENTS

PLAIN BEARING	STANDARD WEIGHT BEARING	HEAVY WEIGHT BEARING
350,000	1,500,000	2,500,000

Table # 5 – Minimum Width of Hinge

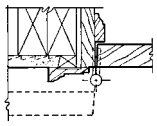
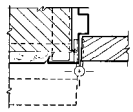
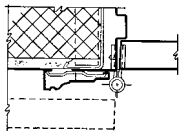
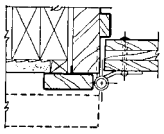
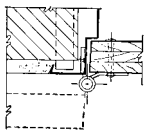
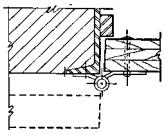
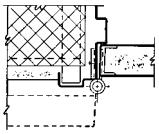
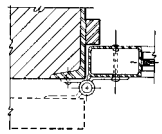
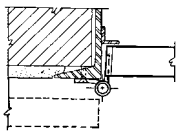
DOOR THICKNESS	WIDTH OF HINGE	MAX. CLEARANCE PROVIDED
1 3/8"	3 1/2"	1 1/4"
	4"	1 3/4"
1 3/4"	4"	1"
	4 1/2"	1 1/2"
	5"	2"
	6"	3"
2"	4 1/2"	1"
	5"	1 1/2"
	6"	2 1/2"
2 1/2"	5"	1"
	6"	2"



Hinge Guide

Use Three Hinges to a Door.
Use Ball Bearing Hinges on Doors Equipped with Closers.

APPLICATION DETERMINES KIND OF HINGE

Wood door w/ wood frame  **FULL MORTISE**	**Wood or composite door w/ hollow metal frame**  **FULL MORTISE TEMPLATE**	**Hollow metal door w/ hollow metal frame**  **FULL MORTISE TEMPLATE**
Composite door w/ composite frame  **HALF SURFACE TEMPLATE**	**Composite door w/ hollow metal frame**  **HALF SURFACE TEMPLATE**	**Composite door w/ channel iron frame**  **FULL SURFACE TEMPLATE**
Composite door w/ hollow metal frame  **FULL MORTISE TEMPLATE**	**Tubular steel door w/ channel iron frame**  **FULL SURFACE TEMPLATE**	**Hollow metal door w/ channel iron frame**  **HALF MORTISE TEMPLATE**

4. Determine type of material

There are three base materials from which hinges are manufactured: Steel, Stainless Steel, and Brass. Each base material has different qualities.

Steel — This has great strength but it is a corrosive material. If the atmosphere that steel is used in is not stable, steel will begin to rust. The best application for steel is in a controlled environment, such as inside a building where the temperature and humidity are controlled.

Stainless Steel — This also has great strength. It is rust resistant and has decorative value in that it can be polished to a satin or bright finish. Stainless Steel can be used in chemical storage or highly corrosive areas and not become rusted. Other considerations may be geographical, such as on the seacoast or in industrial areas where acids or atmospheric conditions exist.

Brass — This material is non-corrosive, rust resistant, and very decorative. However, it has less strength than the steel or stainless steel material. Brass is often used where appearance is of great concern as it may be polished and plated in various finishes.

Both steel and stainless steel hinges may be used on listed fire rated or labeled door openings. Brass material may not be used on fire rated or labeled openings because of the low melting point.

5. Determine type of finish

All steel and brass material hinges can be plated to match the available finishes that are listed in the American National Standards Institute, standard #ANSI/BHMA A156.18 Materials and Finishes. Most finishes are lacquered to resist oxidation or tarnishing of the finish.

6. Determine handing

On some applications it will be necessary to order hinges that are handed. Most manufacturers use the suffix RH (right hand) and LH (left hand). Another general rule of thumb, most manufacturers make the Half Surface, Half Mortise and Full Surface hinges for right hand use. Conversion from right hand to left hand is very simple; take the pin out of the knuckle, remove the bottom plug, turn the hinge over, replace the plug in the bottom and the pin in the top of the knuckle, and the handing is reversed.

There are many methods to determine the proper handing of a door. This is only one of those methods. Please use the method with which you are most comfortable.

- The hand of a hinge is determined from the outside of the door to which it is applied. This is usually the locked side.
- When standing outside, if the door opens away (into the area) to the right, it takes a right hand hinge (also referred to as RH). If it opens to the left, it takes a left hand hinge (also referred to as LH).
- When standing outside, if the door opens toward (out of the area) the right, it takes a left hand hinge (also referred to as right hand reverse bevel - RHRB). If it opens to the left, it takes a right hand hinge (also referred to as a left hand reverse bevel - LHRB).

Note: Handing illustrations are shown on the next page.

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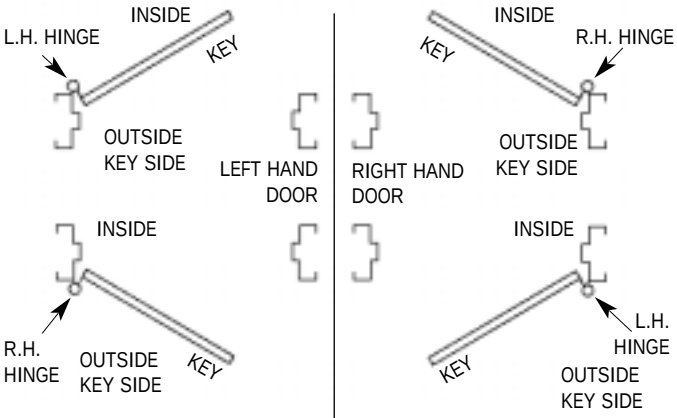
Basic Hinge Selection

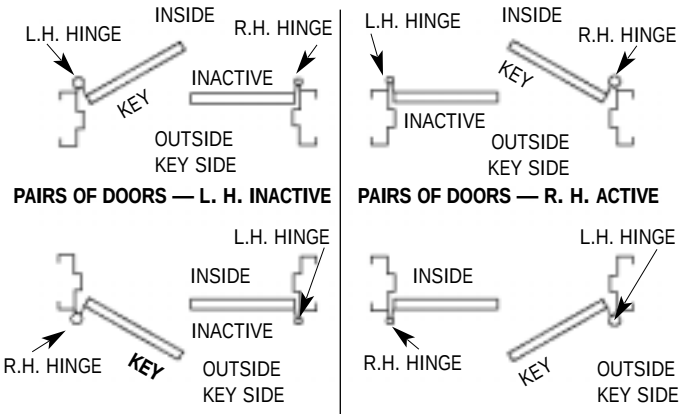
Door & Frame Handing Chart — Single Doors



LEFT HAND REVERSE BEVEL DOOR

RIGHT HAND REVERSE BEVEL DOOR

Door & Frame Handing Chart — Pairs of Doors



PAIRS OF DOORS — L. H. INACTIVE

PAIRS OF DOORS — R. H. ACTIVE

PAIRS OF DOORS L. H. R. B. INACTIVE

PAIRS OF DOORS R. H. R. B. ACTIVE

Hand all doors by standing outside or key side — facing door

7. Electric hinges

With the introduction of electric hinges we now have the ability to monitor the position of the door, transfer power, and incorporate both functions into the same hinge. With this, we now have the ability to electrify other hardware items such as locks, exit devices, and electric strikes.

The electrified hinge provides an easy means to monitor the opening as well as transferring power from the frame into the door.

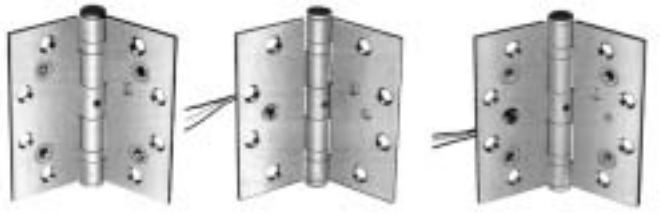
Electric hinges can be modified either exposed on the surface of the hinge or the modifications can be concealed in the hinge. When concealed, the modifications are not visible and normally go undetected by personnel using the openings.

Another important point to remember is an electrically modified hinge is for low voltage power transfer only (48 volts or under). Higher voltages are not allowed because of the potential dangers. Also a consideration is the Amperage rating of the power transfer hinges.

Normally modifications are made to full mortise hinges. However, monitoring can be supplied on a half surface hinge when the need arises.

It is recommended that the **CENTER HINGE LOCATION** be used with all electrically modified hinges.

EXPOSED ELECTRIC HINGE MODIFICATION



E2–2 Conductor Transfer | **E1S–Single Switch** | **E2/E1S–2 Conductor Transfer/Switch**

CONCEALED ELECTRIC HINGE MODIFICATION

EMN–Electric Monitor | **ETW–Through-Wire Transfer** | **ETM–Through-Wire Transfer w/Monitor**

AIR TRANSFER HINGE

8. Other Hinges

Spring Hinges

The next special application hinge is the spring hinge. This comes in two basic types, single acting (full mortise and half surface) and double acting (full mortise, half surface and clamp flange).

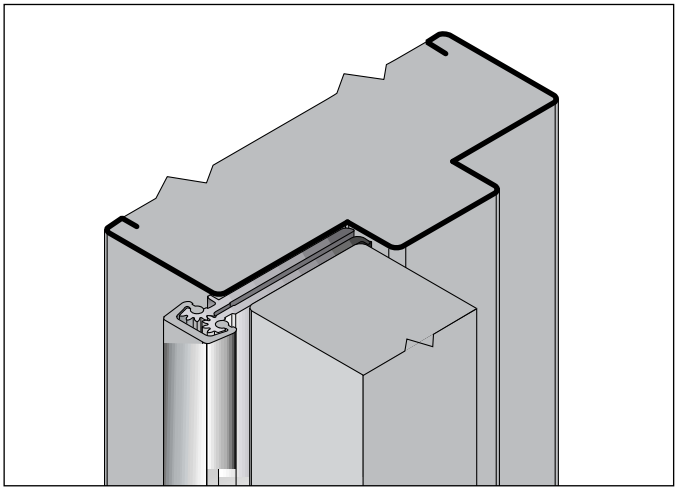
In some cases the spring hinge is used as a substitute for door closers. This is a less costly product than the standard door closer but it does not have the controls or back check features that a door closer will offer.

NFPA 80 has restricted the use of architectural grade spring hinge to fire rated doors of a maximum size of 3'0" x 7'0". If spring hinges are going to be used with additional architectural hinges, they must be ball bearing.
Do not use plain bearing hinges with spring hinges.

The information that will be necessary, as with other hinge requirements, is door height, weight, thickness, and proper number of spring hinges to be used on the opening.

Continuous Geared Hinges

A relatively new concept in hanging doors is continuous hinges. Continuous hinges are designed to distribute a door's weight along the full height of the door frame. By doing so, localized stress typically found with butt hinges and pivots is eliminated allowing smooth operation and a longer life for the door opening.



9. Advanced hinge information

Special Options

When using steel based hinges, special options are available such as stainless steel pins, stainless steel bearings, and bearing jackets. Further options, in lieu of using ball bearings as an anti-friction bearing are:

Oilite Bearings — The oilite bearing (OB) is a bearing made of porous metal that has been press-formed and impregnated with oil. The slight pressure and heat generated when the door is operated causes the oil to come to the surface of the bearing causing the surface to be slick and smooth.

Nylon Bearings — These are made of resilient engineering plastics which provide a self-lubricant and very strong bearing surface. The nylon acts as a cushion for the door yet it allows the door to flow smoothly on the surface of the nylon with an extremely low wear factor.

Care and Maintenance

There is little care or maintenance that needs to be performed on hinges providing they are specified correctly for the proper application. Hospital Tip hinges need to be greased every six to twelve months. Other hinges require only occasional maintenance.
Too often hinges are under-specified and this causes problems for other hardware on the doors as well as for the hinges. The worst thing is that the owner of the building has to accept the situation and compromise with hardware that is less than satisfactory for what is actually needed.

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