

Correct Specification - Conventional Hinges

Factors Determining Selection

An array of external factors will affect the performance of any door set and all these factors should be considered when determining the choice of hinge. The Relcross route to a correct specification is summarized here.

The location and function of the door dictates the frequency of that door's usage. Location will also dictate the base material of the hinge, possibly its finish and definitely any special security features.

A combination of location, function and frequency of use will determine the door construction. Namely the materials used, the door height, width and thickness.

In turn, door construction along with other door hardware used (particularly door closers) are two factors directly influencing the door mass.

Door mass is a primary factor for consideration since this will affect the gauge of the material used in the hinge and the type and number of bearing surfaces necessary for correct load bearing.

The extent of the available overall bearing surface is dictated by the chosen hinge height and the number & type of hinges specified per leaf. Additionally, hinge location will affect greatly the ability of individual bearing surfaces to perform a worthwhile task.

Fasteners are an integral part of the hinge and due consideration should be placed on the correct choice. This choice will be influenced by the construction of the door, the application of the hinge (see below) and any additional security considerations.

Hinge Applications

The 'application' of a hinge refers to its shape and relative mounting position. Different shapes and positions allow hinges to behave differently geometrically and to accommodate varying types of door/frame materials. They can move the door through slightly different arcs thus avoiding obstacles to leave the door offset and out of harm's way. It should be borne in mind that varying the hinge application may affect the performance of door control hardware. Consult the appropriate door control technical binders for guidance in this respect.

The four basic mounting configurations are:

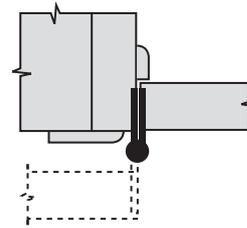
- FULL MORTICE
- HALF MORTICE
- FULL SURFACE
- HALF SURFACE

See the hinge configuration chart (opposite) for an explanation of each application.

Hinge Configuration Chart

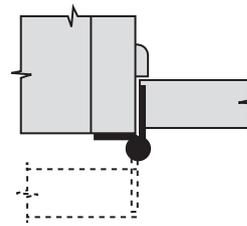
Full Mortice -

Standard configuration with one hinge leaf morticed, or recessed, in the edge of the door & one in the frame.



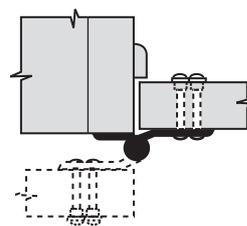
Half Mortice -

For frame assemblies that do not permit morticing - e.g. metal frames.



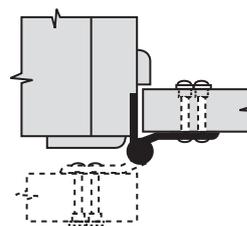
Full Surface -

For door/frame assemblies that do not permit morticing - both leaves are surface applied.



Half Surface -

For doors that do not permit morticing - the door hinge leaf is surface applied and bolted through.



The plan drawings show the general layout of each hinge in a typical situation and are for indication purposes only.

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Door Location & Frequency of Use

Frequency of use can be estimated if you know the location of the door and the function of the building. For example, a school corridor door will be busier than a typical office door in a small solicitors office (see table below). Variations in frequency of use and abuse of a door will affect the performance of the hinge in similar ways to variations in door mass.

Frequency of Door Operation		
Building and Door Type	Daily	Annually
Dept. Store Entrance	5,000	1,500,000
School Entrance	1,250	250,000
Bank Entrance	500	150,000
School Corridor	80	15,000
Office Door	25	6,000

For hinge specification purposes Relcross classifies frequency of use as follows:

- **Low Frequency** - up to 50 full cycle operations per day
- **Medium Frequency** - up to 500 full cycle operations per day
- **High Frequency** - up to 5,000 full cycle operations per day

Door Construction, Dimensions & Mass

Door construction varies according to proposed usage. Inevitably, different materials vary considerably in mass. Mass is an important factor when determining hinge selection and must be one of the primary considerations.

The gauge of the material used in the hinge allied to the correct choice of bearing surface will usually address the mass issue (See page 7).

Timber doors vary in mass dependent upon the source material, e.g. Oak, Ash, Spruce etc. Some timber doors are solid core, some are veneered with a honeycomb infill. Metal doors vary dramatically in mass and construction. Information on door construction should be available from the Architect. If not, check the door manufacturers' technical specifications.

Average (Unadjusted) Door Mass Architectural Grade Doors

Material	44mm kg/m ²	54mm kg/m ²
Hollow Metal	24.40	29.95
Hollow Core	12.20	14.97
Solid Core	22.00	27.00
Mineral Core	19.50	23.93
Pine (White)	17.00	20.86
Oak	34.20	41.97
Ash	24.40	29.95
Mahogany	22.00	27.00

Some heavier doors will require alternative fixing methods, dictated by variations in the hinge application (See page 4).

Wherever possible, Relcross requires the Architect's drawings showing the details of all the doors on the project. It is possible to calculate door mass if you have the dimensional information and you know the door construction material.

Special Materials - Used in Door Construction

Occasionally, special materials are incorporated in a door's construction to facilitate a particular function. Careful attention should be given to such installations and precise dimensional detail should be sought prior to specification of the hinges.

Glass & Lead Lining

Thickness	Glass kg/m ²	Lead kg/m ²
0.4mm	-	4.90
1.6mm	-	18.30
3.2mm	-	36.60
6.4mm	17.00	73.20

Important Note - All the information shown on this page is 'typical' and is for guidance only. For precise information on door mass consult the door manufacturer. For a summary of other factors affecting door mass calculation please refer to page 6.

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Factors Affecting Door Mass Calculation

Door Closers

Since all Relcross door hardware is designed for commercial grade installations, invariably the doors we deal with are fitted with overhead door closers. Relcross recommends closers exclusively from the LCN Closers range. All LCN door closers incorporate a back-check feature as standard.

Annexe E of BS EN 1935:2002 states that door closers increase the loading on hinges and their rate of wear. It is a safe assumption that doors fitted with correctly templated and adjusted LCN door closers have an effective door mass 75% greater than the measurable mass.

Excessive Door Width

This affects the adjusted door mass since wider doors increase the bending moment acting upon the hinges. This is compensated for by a reduction in the maximum door mass supportable by each class of hinge. To accommodate this 'reduction' we must increase the adjusted door mass by an appropriate level. This increase is calculated as follows and is summarized in the table below.

■ Factor = $\frac{\text{Height}}{\text{Width}}$ e.g. $\frac{2000}{1150} = 1.74$

■ Normal Increase (%) = $\frac{2.00 - \text{Factor}}{0.01}$

e.g. $(2.00 - 1.74) / 0.01 = 26\%$

Additional Mass for Wider Elements Door Height 2000mm		
Door Width	Factor	Normal Increase
1000mm	2.00	0%
1050mm	1.90	10%
1100mm	1.82	18%
1150mm	1.74	26%
1200mm	1.66	34%
1250mm	1.60	40%

Increased Door Height

Door height affects the number of hinges used. The hinge selection chart (See page 8) assumes three hinges per door and accommodates situations where neither the door's height nor width exceeds the stated parameters.

You will see on page 7 that all doors require one additional hinge for each 760mm of height above 2290mm.

Clearance of Trim

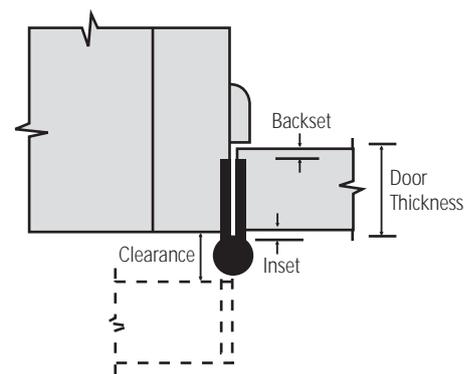
What do we mean by clearance of trim?

So far as hinges and pivots are concerned, 'trim' refers to the frame and any surrounding features in close proximity to the opening. These features become important if they interfere with the door during a normal opening and closing arc. When specified correctly, the hinge must enable the door to avoid these features completely, or where appropriate, to take them into account.

The following table shows standard Relcross hinge widths and the clearance they provide on standard door thicknesses.

Trim Clearance by Hinge Width		
Min. Open Width of Hinge	Door Thickness	Clearance Provided
89mm	35mm	<32mm
102mm	35mm	<44mm
102mm	44mm	<25mm
114mm	44mm	<38mm
114mm	54mm	<25mm

Formula to Determine Hinge Width - Where Additional Clearance is Required



■ $((\text{door thickness} - \text{backset}) \times 2) + \text{clearance} + \text{inset}$
= minimum open hinge width required

Decorative features such as architraves can be common problems, but more usually particularly deep reveals pose greater problems. Deep reveals will, in some instances, restrict a door's ability to open past 90°.

For other hinge applications:

Full Surface, Half Surface & Half Mortice:

Clearance is dictated by the offset of the hinge (i.e. its pivot point) rather than its width.

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Choosing a Suitable Bearing Surface

A combination of the mass of the door and its frequency of use will determine whether the hinge you choose is from our Heavy Weight or Standard Weight options.

The **Heavy Weight** and **Standard Weight** options comprise hinges with anti-friction* bearings exclusively. Heavy weight hinges should be always used on heavy doors (See page 8) and doors where high frequency service is expected.

*Anti-friction bearings include the following two options:

- The **CB Series** - Three knuckle **CB** series concealed bearing hinges are our top of the range architectural solution. Built around a proven two-piece concealed bearing system that never needs maintenance, the **CB** bearing provides both lateral and vertical support.



(See pages 10 & 11 for further details).

- The **FM Series** - Ball bearing hinges have become the industry standard in many commercial and institutional applications. The ball race comprises hardened chrome alloy bearings and a (type 1008) steel sustainer for vertical support.



A plated steel or stainless steel non-rising pin is included for lateral support.

(See www.relcross.co.uk for further details).

For very light duty, low frequency door applications the **F Series** plain bearing hinge will usually suffice - (not shown in this brochure). Please consult the sales office for further information on this type of hinge.

Gauge of Hinge Material

The gauge of the metal used in the construction of the hinge varies between **Heavy Weight** and **Standard Weight** and over the different hinge size options (See the table below).

Gauge of Metal		
Hinge Size – mm Height x Width	Heavy Weight	Standard Weight
100/76 (REL.FM)	–	3.0mm
102/76 (REL.CB1960R)	–	3.3mm
102/89 (REL.CB1960R)	–	3.3mm
102/102 (REL.CB1960R)	–	3.3mm
114/102 (REL.CB1960R)	–	3.4mm
114/114 (REL.CB1961R)	4.6mm	–

Number of Hinges Required

A combination of the quantity of hinges specified along with their size and type will dictate the extent of the available bearing surface.

Hinge Numbers	
Door Height	Quantity
<1520mm	2
<2290mm	3
<3050mm	4
<3810mm	5
<4570mm	6

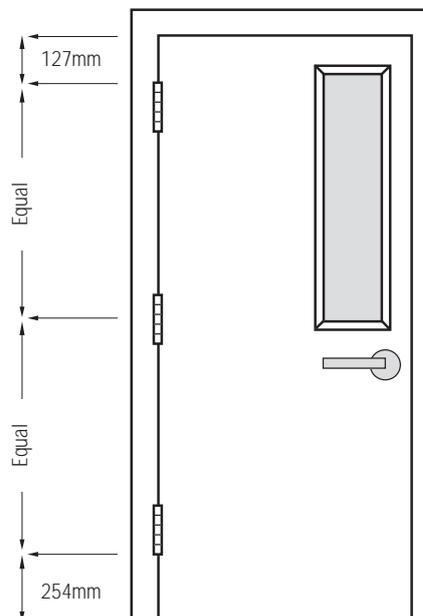
Typically, conventional doors in commercial situations are <2290mm in height and invariably call for 3 hinges per leaf. As a result, the majority of hinges detailed in this brochure are packaged in boxes of three.

Hinge Positions - Relative to Door Sizes & Mass

When fixing hinges certified to BS EN 1935:2002 Relcross recommends that the guidance detailed therein is followed.

Where hinges are to be used on fire doors then the information detailed in the fire test report is the overriding factor and should be followed accordingly.

For all other installations Relcross recommends the following:



Where door height dictates that additional hinges are required they should be fixed adjacent to and immediately below the top hinge.

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Drawing The Specification Together

After establishing the criteria outlined in the previous pages it is necessary to apply this detail to the following table to determine hinge class, height & width.

Hinge Selection Guide (for Doors 2000mm x 1000mm)					
Unadjusted Door Weight / Kilos (not exceeding)	45kg	45kg	54kg	68kg	100kg
Adjusted Door Weight* / Kilos (not exceeding)	80kg	80kg	95kg	120kg	175kg
Door Thickness (minimum)	35mm	44mm	44mm	44mm	54mm
Hinge Size – mm (height/open width)	102/76	102/89	102/102	114/102	114/114
Gauge of Metal	3.3mm	3.3mm	3.3mm	3.4mm	4.6mm
Quantity of hinges per 2000mm x 1000mm Door	3	3	3	3	3
Anticipated Cycles / 24 Hours (Max.)	Class Code Polished Brass Plated Stainless Steel Satin or Bright Stainless Steel		CE Marked Hinges – BS EN 1935:2002 & EN 1634-1:2000 – E30 & E60		
<50 (low)	REL.FM**	✓			
<500 (medium)	REL.CB1960R	✓	✓	✓	✓
<5000 (high)	REL.CB1961R				✓

*Assumes doors fitted with LCN Overhead Door Closers

**FM hinges are 100mm x 76mm x 3mm gauge only

Class Code - Key

- REL.FM - Ball Bearing (Standard Weight) - Grade 13
- REL.CB1960R - Concealed Bearing (Standard Weight) - Grade 13
- REL.CB1961R* - Concealed Bearing (Heavy Weight)

*REL.CB1961R is not a CE marked hinge

Using The Table

The information contained in the table above is offered strictly as a guide to assist in the selection of hinges for normal situations. The major factors affecting hinge selection are addressed but no attempt has been made to include extraordinary factors such as abuse, impacts, hostile atmospheres or other such conditions that can, and often do, affect hinge performance.

The unadjusted/adjusted door weights listed (for CE marked hinges) are maximum figures allowable for doors expected to perform only to the criteria outlined in BS EN 1935: 2000 for Grade 13 hinges.

If your door falls within the standard criteria so far as sail area is concerned (i.e. height x width) then hinge selection becomes relatively straight-forward.

It is important to adjust the door weight where excess door width is a factor (See page 6) and to include additional hinges where excess height is a factor (See page 7).

All the standard weight hinge types shown are CE marked and can be used on fire escape doors and most fire doors - check certification requirements before final specification.

Creating the Hinge Code

Read off the class code and use the appropriate hinge size (height/open width) as a suffix to the code.



For example:

REL.CB1960R.102.89 signifies a concealed bearing standard weight hinge measuring 102mm high x 89mm open width.

Finishes

- US3 - Polished Brass Plated Stainless Steel
- US32 - Polished Stainless Steel
- US32D - Satin Stainless Steel

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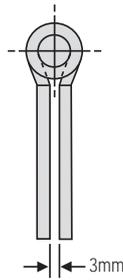
hingefeatures

Hinge Features - Standard & Optional

This section describes features available by default (or to special order) on all the hinges described in the preceding section.

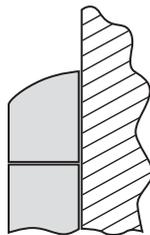
Hinge Swaging (standard 3mm)

Swaging is a slight offset of the hinge leaf at the barrel permitting the leaves to come closer together when parallel. Standard swaging on Relcross hinges is 3mm. A 3mm swage is usually sufficient to accommodate most seals and intumescent materials.



Hospital Tips - Anti-Ligature (optional)

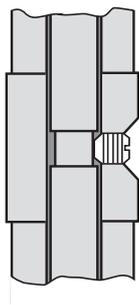
Hospital type barrel ends are sloped, making cleaning easier and making it difficult to attach ropes, clothing apparel and other items. The pin is held in place by a cross pin for increased security.



Use prefix **HT** - when ordering

Non-removable Pin (Optional)

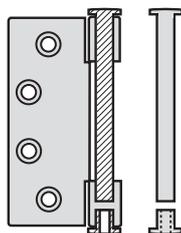
Enhanced security is available as an option in the form of a non-removable pin. A set screw in the barrel intercepts a small groove in the loose pin (see drawing). The set screw is not accessible when the door is closed.



Use suffix **NRP** - when ordering

Pin Design (standard)

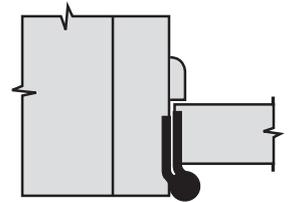
The non-rising pin construction features an easily seated pin that will not rise. A hole in the bottom tip provides for easy pin removal. The pin is removed by inserting a punch or a punch-like tool through the bottom hole of the tip and tapping upwards. This helps prevent marring of the hinge finish during pin removal.



(REL.CB1960R and REL.CB1961R only).

Raised Barrel (optional)

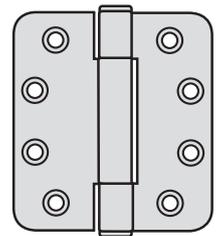
Used where doors are set deep in a reveal. The pivot point is offset at an angle of 45° allowing the hinge barrel to sit inside the reveal. Bending the barrel in this manner will produce unequal leaves. Hinges may be ordered with equal leaves if required. All raised barrel hinges are handed LH or RH. The sketch shows a plan view of a RH hinge.



Use prefix **RB** - when ordering

Radius Corners (optional)

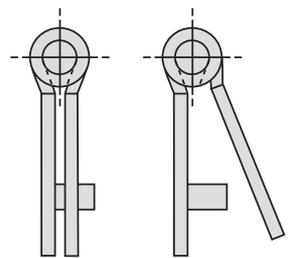
Standard Relcross hinge designs are offered with square corners by default. Radius corner hinges will aid installation when using a router (a power tool with a shaped cutter) for installing full mortice hinges to timber doors and frames. A 16mm radius is common.



Use prefix **RD** - when ordering

Security Stud (optional)

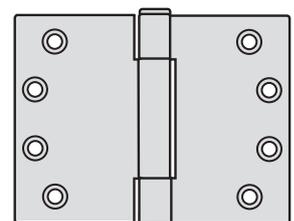
Full mortice hinges are available with studs for added security. With the door in its closed position, a stud attached to one leaf of the hinge projects into a hole in the matching leaf. The hinged side of the door cannot be moved, even with the hinge pin removed, since the stud prevents the leaves from being slid apart.



Use prefix **SEC** - when ordering

Wide Throw Hinge (optional)

A full mortice hinge with wider than normal leaves. Used when doors are set in a reveal and are required to open 180°.



Use prefix **WT** - when ordering

(See 'Clearance of Trim' - page 6)