



# Appendix 2 Fuse-link Reference System

Again, because of the variety of Bussmann High Speed Fuses, the reference system as contained in our program today is rather complex. The use of one particular reference system in Europe outside UK, another one in the UK, and a third system in the US has become a fact of life. Over the years, with the acquisitions made by Bussmann, it has of course been discussed on several occasions to change all references and to have only one system instead. However, all systems have been around for a long time, and the references today are so well known in the respective market concentrations for particular styles that we have decided to maintain the existing systems.

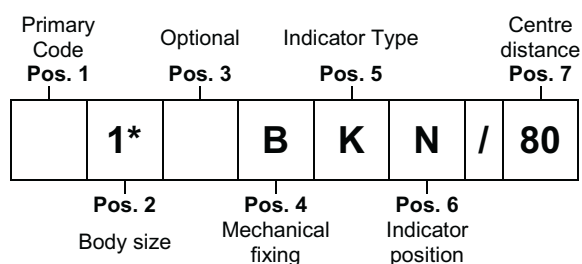
Below, we will therefore describe the Bussmann reference system in detail, - style by style.

## Reference system for European High Speed Fuses

A typical fuse from our European Range could have a part number like for example 170M3473. However, this will not give any guide to what rating or what fixing this fuse will have. Here, the user will first of all need to know the rating. But the fixing is obviously also of interest, and here we use a Type Description to determine what style is in question. Fuses according to the German DIN 43620 standard are always listed by type, as for example DIN 3, DIN 00, etc. But for other fuses, according to DIN 43653, flush-end types, or special types, this description will reveal the actual type in question. For the reference given above, the type designation will be the following:

1\*BKN/50

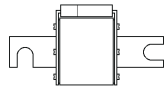
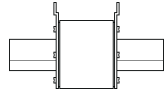
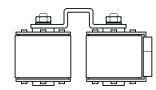
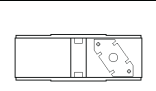
To interpret this Type Code we have made the following general guideline, which will cover most of the fuses in the European programme:



The following tables show the various options for all above positions in the Type Description:

### Pos. 1 - Primary code

The primary code can be one of the following values:

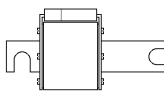
None	DIN 43653 or other style	3KN/110	
DIN	DIN 43620	DIN 3	
2//	Two fuses in parallel connected with fish joint	2//3BKN/100	
2	Two fuses in parallel integrated between plates	24BKN/85	

### Pos. 2 - Body size

0000	17x17 mm	0000U/80	
000	21x36 mm	000/80	
00	30x47 mm	DIN 00	
0	35x45 mm	0S/55	
1*	45x45 mm	1*BKN/90	
1	53x53 mm	DIN 1	
2	61x61 mm	2TN/110	
3	76x76 mm	2//3SBKN/55	
4	105x105 mm	4PKN/150	
4+	115x115 mm	24+BKN/55	
5	159x159 mm	5BKN/65	

### Pos. 3 - Optional

Over the years, Bussmann has become known as a supplier who is able to adapt to customer needs. Therefore, a lot of customised, special fuses are now a part of the product offering. Pos. 3 in the Type Description might therefore be an »S« for special. For all such references, please consult Bussmann for a mechanical drawing, if this is not already at your disposal.

S	Customised fuse	2SKN/210	
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### Pos. 4 - Mechanical fixing

None	Slotted Blade type DIN 43653	2TN/110	
F	US or BS 88 blade style	1*EKE/78	
B	Flush-end version - metric thread	3BKN/50	
G	Flush-end version - US thread	1GKN/50	
D	Double Bolt, flush-end version - metric	3DKN/65	
E	French style blades	1EKN/86	
P	Press Pack	3PKN/85	
H	Blade, without slots (not DIN 43620)	3SHT	

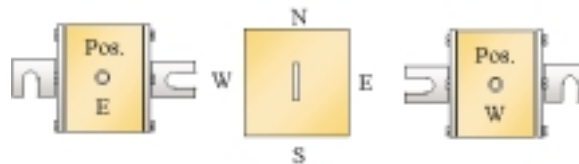
### Pos. 5 - Indicator type

It is quite common that a fuse will have some type of indicator to show if it has operated. Some indicators are built in and some have to be fitted externally. Optionally they are able to trigger microswitches for remote operation. On the Indicator Pos. 5 in the Type Description, the following options are standard:

None	Standard visual indicator	1/80	
U	No indicator	2U/110	
K	Adapter type indicator mounted on the fuse prepared for microswitch	3KN/110	
T	Tag-type indicator prepared for microswitch	2IN/110	

### Pos. 6 - Indicator position

The indicator position may vary from product to product. Standard fixation is the so-called Position N (North) and alternative positions are E (East), W (West), and S (South):

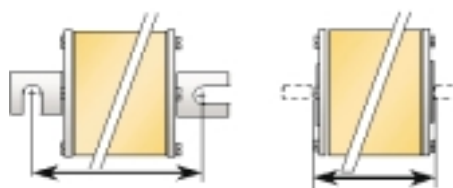


(European projection)

N	North position (standard fixation)	2KN/110	
E	East position	1FKE/78	
W	West position	2KW/110	
S	South position	2SKS/110	

### Pos. 7 - Centre distance

Indicates centre distance for mounting, or overall length of fuses with flush end contacts, stated in millimetres.

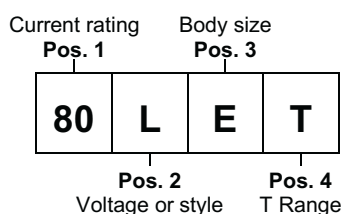




## Reference system for BS88 High Speed Fuses

Since fuse-links were first produced in the dimensions that became standardised in BS88 part 4, fuse-link technology has improved. It is now possible to manufacture fuses with many different operating characteristics. In these dimensions Bussmann High Speed fuses are available in two speed ratings. The T range and the F range. Fuse-links can be selected according to the following codes.




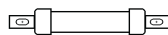
### T Range



#### Pos. 1 - Current Rating




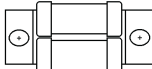
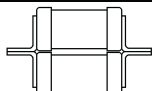
The continuous current rating in amperes

#### Pos. 2 - Voltage or style

<b>L</b>	Voltage rating 240 volts. Fixings as BS 88 part 4	80LET	
<b>A</b>	Voltage rating 660 volts. Fixings 80 mm	80AET	
<b>C</b>	Voltage rating 660 volts. Fixings 110 mm	250CMT	
<b>None</b>	Voltage rating 660 volts. Fixings as BS 88 part 4	20CT	

#### Pos. 3 - Body Style

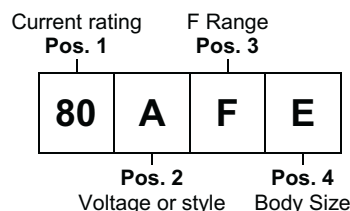
In BS88 part 4, fuse-links have three diameters. Bussmann indicates which diameter the fuse-link has by use of a letter in position 3. To achieve additional current ratings of fuse-links, it is possible to place two fuse-links in parallel. Bussmann provides such fuse-links, and to indicate that two fuse barrels are used, the letter indicating the diameter is repeated.

<b>C</b>	8.4 mm	6CT	
<b>E</b>	18 mm	35LET	
<b>M</b>	38 mm	315LMT	
<b>EE</b>	2 x 18 mm	140EET	
<b>MM</b>	2 x 38 mm	710LMMT	

#### Pos. 4 - T range

The Bussmann T range has a T in this position. Some special purpose fuse-links in 'standard' dimensions or with special fixing arrangements may have an alternate letter in this position. Contact Bussmann for details. For example, 80LET is an 80 ampere, 240 volt fuse-link, 18 mm diameter. 160AEET is a 160 ampere, 660 volt fuse-link with two 18 mm diameter barrels and 80 mm fixings.




### F Range



#### Pos. 1 - Current Rating

The continuous current rating in amperes

#### Pos. 2 - Voltage or style

<b>A</b>	Voltage rating 660 volts. Fixings 80 mm	20AFE	
<b>C</b>	Voltage rating 660 volts. Fixings 110 mm	250CFM	
<b>No mark</b>	Voltage rating 660 volts. Fixings as BS 88 part 4	80FE	





### Pos.3 - F range

The Bussmann F range (these fuse-links are faster acting than the T range) has an F in this position.

### Pos. 4 - Body Style

In BS88 part 4, fuse-links have three diameters. Bussmann indicates the diameter of the fuse-links by means of a letter in position 4. To achieve additional fuse-link current ratings it is possible to place two fuse-links in parallel. Bussmann provides such fuse-links and to indicate that two fuse barrels are used, the letter indicating the diameter is repeated.

<b>C</b>	8.4 mm	
<b>E</b>	18 mm	35FE
<b>M</b>	38 mm	200FM
<b>EE</b>	2 x 18 mm	180FEE
<b>MM</b>	2 x 38 mm	630FMM

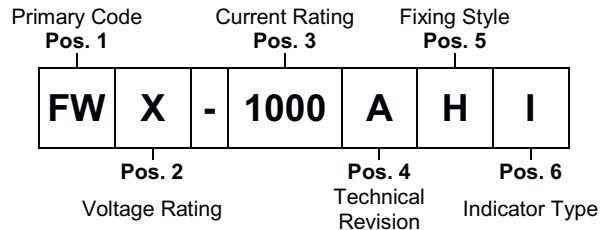
For example, 80FE is an 80 ampere, 660 volt fuse-link, 18 mm diameter.

### Reference system for US High Speed Fuses

Like the fuse-links in European square and round bodies have descriptive type numbers, the US fuses in the Bussmann programme have descriptive part numbers. To date there is no recognised US dimensional standard for high speed fuse-links, but there are accepted industry standards. Bussmann fuse-links meet these standards. The following tables show the various options for all above positions in the Type Description.

### Standard programme - type FW

Fuse-links can be selected by the following codes:



#### Pos. 1 - Primary code

All Bussmann US style high speed fuse-links in the standard program are designated by the prefix FW.

#### Pos. 2 - Voltage rating

The AC voltage rating of the fuse-link.

<b>A</b>	130 or 150	FWA-80A
<b>X</b>	250	FWX-1A14F
<b>H</b>	500	FWH-175B
<b>C</b>	600	FWC-12A10F
<b>P</b>	700	FWP-15A14F
<b>K</b>	750	FWK-5A20F
<b>J</b>	1000	FWJ-20A14F
<b>L</b>	1250	FWL-20A20F
<b>S</b>	1500	FWs-15A20F

#### Pos. 3 - Current Rating

For Bussmann high speed fuse-links this is usually the continuous current rating.

#### Pos. 4 - Technical Revision

Bussmann constantly improves the performance of its products. The Bussmann FW range also represents a range consolidated after several acquisitions. When this occurs with products in the main programme, it is necessary to distinguish each technical revision without changing all the part numbers. In common with the semiconductor industry, Bussmann uses a letter code for this purpose. For technical reasons it may be necessary to maintain more than one of these revisions for some applications. Most applications should use the latest revision, however.

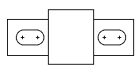









<b>No mark</b>	The first version of this product	
<b>A, B, C etc.</b>	Later improved version	FWP-10B





### Pos. 5 - Fixing style

Most of the FW type fuse-links have centre blades with fixing holes. However, flush end fixings (often called Hockey Puck) are common and so are the cylindrical bladeless types.

<b>Empty</b>	Standard blade	FWX-90A	
<b>H</b>	Flush end fixings – imperial thread	FWX-1000AH	
<b>BB</b>	Flush end fixings – metric thread	FWA-2000ABB	
<b>**F</b>	Cylindrical blade-less (ferrule) where ** is the diameter in mm of the end cap	FWH-30A6F  FWC-20A10F  FWH-30A14F  FWA-35A21F  FWP-100A22F  FWK-25A20F  FWK-60A25F 	

Note: Where F is in position 5, the first version of the product will be designated with an A

### Pos. 6 - Indicator

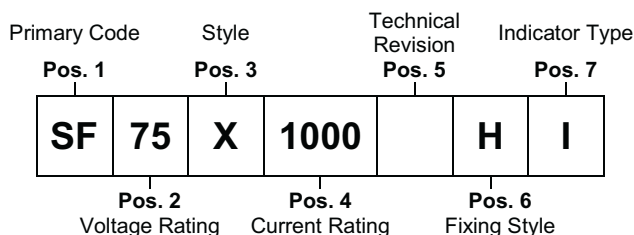
As standard, the FW range products do not have visual indication of fuse operation.

<b>Empty</b>	Standard product
<b>I</b>	Indication by additional external type T1 indicating fuse that also takes MA type microswitch (see BS style accessories)
<b>SI</b>	Indication by external indicator that also takes 170H0069 microswitch.

### Special Programme - types SF and XL

In addition to the standard programme of FW fuse-links, Bussmann offers special purpose fuse-links and also a range of higher speed versions as an alternative to some of the FW range.

Fuse-links can be selected by the following codes:



### Pos. 1 - Primary code

Bussmann's US style high speed and special purpose fuse-links are designated by the prefix SF or XL.

### Pos. 2 - Voltage rating

Generally, this is one tenth of the AC voltage rating of the fuse-link. For special purpose fuse-links please check with Bussmann.

### Pos. 3 - Style

<b>F</b>	High speed performance This often also means good dc voltage performance
<b>X</b>	Slow speed, often for traction applications

This is only an indication of the letters used, others may be used for special purpose fuse-links

### Pos. 4 - Current Rating

For standard Bussmann high speed fuse-links this is usually the continuous current rating. For other types this position may only be an indication of capabilities, as many of these designations are agreed with OEMs for special applications.

### Pos. 5 - Technical Revision

Bussmann constantly improves the performance of its products. When this occurs with products outside our main program, it is necessary to distinguish each technical revision without changing all the part numbers. In common with the semiconductor industry, Bussmann uses a letter code for this purpose. For technical reasons it may be necessary to maintain more than one of these revisions for some applications, however most applications should use the latest revision.

<b>No mark</b>	The first version of this product
<b>A, B, C etc.</b>	Later improved versions

### Pos. 6 - Fixing style

Most of the SF and XL type fuse-links have centre blades with fixing holes.

<b>Empty</b>	Standard blade
<b>HP</b>	Flush end fixings – imperial thread
<b>BB</b>	Flush end fixings – metric thread
<b>others</b>	Agreed with OEM

### Pos. 7 - Indicator

<b>Empty</b>	Standard product
<b>I</b>	Indication by additional external type T1 indicating fuse that also takes MA type microswitch (see BS style accessories)
<b>M</b>	Microswitch fitted





## Appendix 3. Installation Issues

High Speed Fuses are highly sophisticated electrical devices and due care must be taken regarding proper installation and maintenance. This to ensure reliable function throughout the natural lifetime of the fuse. In this chapter we will cover various issues like:

- Tightening torque and contact pressure.
- Mounting Alignment.
- Surface materials of contacts.

Other issues of more general character will also be addressed:

- Resistance to vibration & shock
- Service/maintenance
- Environmental issues.

### Tightening torque and contact pressure

High Speed Fuses are electro-mechanical devices. Their function is very much dependent of the quality of the contact between the fuse and the connecting cables/ busbars or between the fuse and fuse-holder. This for several reasons: of course a proper electrical contact is needed, but it is also important to remember that High Speed Fuses generate a lot of heat, which is partly to be removed through the connections. A poor thermal connection can result in overheating of the fuse and reduced lifetime. The number one rule is therefore to observe the right tightening torque when mounting the fuse.

### Fuses with flush end contacts.

For all kinds of flush end fuses Bussmann recommends (screw in) studs according to DIN 913. The studs must be tightened carefully applying a torque of 5-8Nm. As a general rule the tightening torque for the nuts relates to the dimension of the threaded hole in the fuse contact. In the following the recommended nut tightening torques are given:

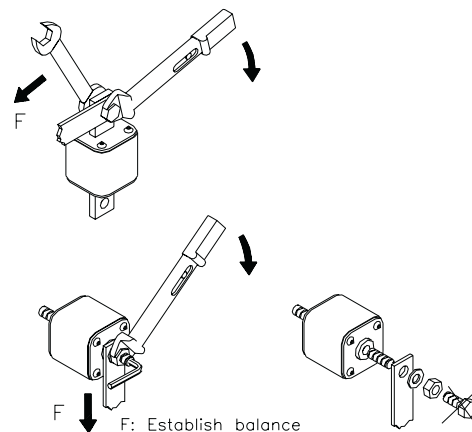
Size/type	Threaded hole mm - inch	Tightening torque	
		Nm *)	Nm**)
00B	M8	20	10
1*B - 1*G	M8 - 5/16	20	10
1B - 1G	M8 - 5/16	20	10
2B - 2G	M10 - 3/8	40	20
3B - 3G	M12 - 1/2	50	40

Size/type	Threaded hole mm - inch	Tightening torque	
		Nm *)	Nm**)
23B - 23G	2xM10 - 2x3/8	40	20
4B - 4G	4xM10 - 4x1/2	40	20
24B - 24G	3xM12 - 3x1/2	50	40
5B - 5G	5xM12 - 5x1/2	50	40
FWX,FWA, KBC	3/8	40	20

\*) Ungreased thread

\*\*\*) Thread greased with Rhodorsil Paste 4 (Rhone-Poulenc) etc.

Bussmann recommends a calibrated torque wrench with a tolerance of max.  $\pm 4\%$ .



### Special flush-end types

Special types like for example 4SB or 24SB normally have threaded holes in one end only and a plate in the other for mounting on (water cooled) busbars. In such cases the screw-in studs and nuts are used for the threaded holes as indicated in the above table. The plates are mounted on busbars at torque of 50Nm.

### Fuses with contact knives

In general this type of fuses can be divided into two main groups. Fuses with slotted knives according to the DIN 43653 standard for mounting direct on busbars or in special fuse holders and fuses with solid knives according to the DIN 43620 standard for mounting in spring-loaded fuse bases.



## DIN 43653 - on busbars

Fuses for mounting on busbars are to be tightened with the biggest possible bolts/studs, nuts and washers. Use of washers is recommended. The bolts/nuts are tightened with a torque of 50Nm.

## DIN 43653 - in fuse bases.

Fuses for mounting in special made fuse bases must be tightened according to the specification provided with the base. Maximum tightening torque for some Bussmann bases are given below:

Part number	Bolts for holder Nm *)	Bolts for cables/fuses Nm *)
170H1007	4 (M6)	12 (M8)
170H3003 – 170H3006	10 (M8)	20 (M10) **)
	Conductor set screw lbs-in	Fuse Mounting Bolt lbs-in
1BS101	120	70
1BS102	275	120
1BS103	275	170
1BS104	375	170
BH-1,2,3	---	---

1 lbs-in x 0.11298 = 1 Nm

\*) Note: Thread greased with Rhodorsil Paste 4 (Rhône-Poulenc) etc.

\*\*) Note: For 170Hxxxx bases the above values can be raised by 25% if no plastic parts are stressed.

## DIN 43620

This kind of bases is equipped with one or more springs providing the correct contact pressure when the fuse is pressed into the base. For this reason no tightening recommendations are given. For Bussmann bases 170H3040-47 a maximum tightening torque of 10Nm can be used when mounting the holder itself into the equipment.

## Press Pack fuses.

Some of the most common semiconductors must be stack mounted under a certain clamping force. A range of so-called press pack fuses in type 3P and 4P are available and enables the user to reduce the number of components by clamping the semiconductor and the fuse together with the water cooling boxes in a single mounting arrangement. The maximum clamping force a fuse can withstand depends on many details such as: length and cross section area of the fuse body, temperature gradient between the fuse contacts and also the electrical load conditions.

Example values for maximum clamping force can be found in the tables below.

Size	Single-sided cooling kN	Double-sided cooling kN
3P/55	22	30
4P/60	40	50
3P/80	30	40
4P/80	50	60

To ensure safe electrical and thermal contact between fuse-contact and cooling box or busbar and at the same time avoid the risk of damaging the fuse contact, the contact pressure (Pf) should lie between the following limits:

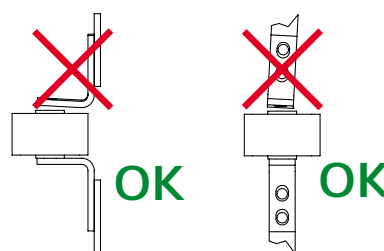
$$2\text{N/mm}^2 < P_f < 15\text{N/mm}^2$$

For fuses cooled in one end a maximum temperature gradient of 55K between the fuse contacts must be observed. For fuses used with double-sided water cooling, the temperature gradient between the fuse contacts is expected to be negligible.

Special made Press Pack fuses are also made in the double body construction type 24B or 24+B. Many details must be considered when using this kind of fuses under pressure - please consult Cooper Bussmann Application Services.

## Mounting Alignment

Bussmann High Speed fuses are generally supplied in a ready-to-install condition. The fuses are not meant as fixing isolators. Excessive push, pull and tensional forces due to misalignments between fuse and bus bars, which might occur like in below given example, should be avoided. If possible the mounting should be made starting with the fuse followed by the necessary adjustment and tolerance utilisation of the bus bar components, when mounting the rest of the fixing.





## Surface material

The various electrical conducting metal parts of Bussmann High Speed fuses are usually plated to maintain longevity of the surface condition. The most common material for the fuse contacts today is tin.

## Tin plated contacts

Most contact surface of Bussmann High Speed fuse-links are electro-plated with a 5m $\mu$  layer of tin. This surface treatment provides an excellent electrical and thermal interface to bases or cables/busbars of either pure copper or copper/aluminium plated with tin/nickel or silver.

	Concentration – duration PPM – h	According to standard
H <sub>2</sub> S	12,5ppm – 96h	IEC 68-2-43 Kd
SO <sub>2</sub>	25ppm – 504h	IEC 68-2-42 Kd

Many tests and more than 30 years of experience have shown that a tin, nickel or silver plated surface is both mechanically and electrically stable in the entire temperature area for High Speed fuses (typical maximum temperature rise of 130K).

## Resistance to vibration and shock.

In general, High Speed fuses should not be submitted to excessive vibration. However, standard High Speed fuses can withstand vibration with a magnitude of maximum 5g on a long-time basis and 7g for short periods (shocks). Before using fuses in applications with stronger vibration please consult Cooper Bussmann Technical Applications Services.

## Service and maintenance

The following points should be observed during maintenance.

## Check points during routine maintenance of electrical cabinets and switchgear.

The tightening torque should be checked, and ceramic fuse bodies should be checked for visible cracks.

All blown fuse indicators must be checked. In case of any fuse operation the following procedure must be observed: Change all operated fuses AND fuses which have not operated but have been loaded with the fault current or a part of it. Please note that even if the ohmic resistance of the fuse is unchanged, the fuse may be damaged by the fault current and must be changed to avoid nuisance fuse operation.

## Environmental issues

### Basic materials

High Speed fuses are made from the following basic materials: ceramic/fibreglass, silver, copper, brass, steel, and sand. Accessories like micro switches and fuse holders are partly made of various plastic materials.

For further information on materials, contact Bussmann technical services.

### Storage

Fuses should be stored in their original boxes or containers and under typical warehouse conditions for electro-mechanical products, i.e. free from any dirt and dust. The relative humidity at long term storing must not exceed 70% and the storage temperature should be in the -40°C to +85°C range.