

Performance With Safety



Switch-Disconnect-Fuse
Type FN



Switchgear Factory, Navi Mumbai



Switchgear Factory, Ahmednagar



Switchgear Factory, Vadodara

ABOUT US

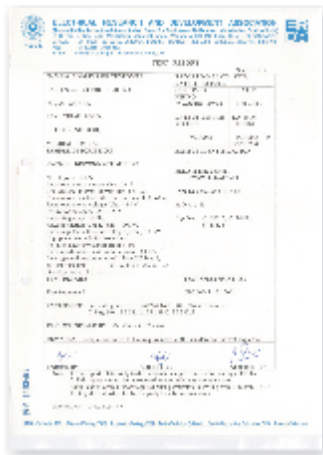
Larsen & Toubro is a technology-driven company that infuses engineering with imagination. The Company offers a wide range of advanced solutions in the field of Engineering, Construction, Electrical & Automation, Machinery and Information Technology.

L&T Switchgear, a part of the Electrical & Automation business, is India's largest manufacturer of low voltage switchgear, with the scale, sophistication and range to meet global benchmarks. With over five decades of experience in this field, the Company today enjoys a leadership position in the Indian market with a growing international presence.

It offers a complete range of products including powergear, controlgear, industrial automation, building electricals & automation, Power Quality Solutions, energy meters, and protective relays. These products conform to Indian and International Standards.

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Switch-Disconnecter-Fuse range comply with following standards

- **IEC 60947-1, EN 60947-1, IS/IEC 60947-1**
Low-voltage switchgear and controlgear, Part 1: General Rules
- **IEC 60947-3, EN 60947-3, IS/IEC 60947-3**
Low-voltage switchgear and controlgear, Part 3: Switches, disconnectors, switch-disconnectors and fuse combination units

NABL



NABL accreditation is a formal recognition of the technical competence of testing, calibration or medical laboratory for a specific task following ISO/IEC 17025:2005 Standard. Accredited laboratories have the responsibility of satisfying the criteria of laboratory accreditation at all times, which are verified during Surveillance and Reassessment visits by NABL. Further the accredited laboratories should prove their technical competence by satisfactory participation in recognized Proficiency Testing Programmes.

L&T's Switchgear Testing Lab is NABL accredited subject to continued satisfactory compliance to above standard & additional requirements of NABL.

Switch-Disconnecter range is tested in L&T's NABL accredited Switchgear Testing Lab.

CE Marking




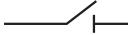
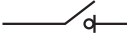



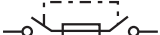
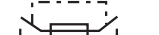
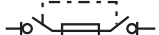






A CE marking is a European marking of conformity that indicates a product complies with the essential requirements of the applicable European laws or directives with respect to safety, health and environment and consumer protection. Generally, this conformity to the applicable directives is done through self-declaration and is required on products in the countries of the European Economic Area (EEA) to facilitate trade among the member countries. The manufacturer or their authorized representative established in the EEA is responsible for affixing the CE marking to their product. The CE marking provides a means for a manufacturer to demonstrate that a product complies with a common set of laws required by all countries in the EEA to allow free movement of trade within the EEA countries.

L&T's Switch-Disconnecter range conform to the Low voltage directive 73/23/EEC as amended by directive 93/68/EEC, provided it is used in the application for which it is made and is installed and maintained in accordance with professional practices with relevant installation standards and operating instructions.

All about switches

Different Switch representations according to IEC 60947-3

Table 1 - Summary of equipment definitions

Function		
Making and breaking current	Isolating	Making, breaking and isolating
Switch 	Disconnecter 	Switch-Disconnecter 
Fuse combination units		
Switch-fuse single break 	Disconnecter-fuse single break 	Switch-disconnector-fuse single break 
Switch-fuse double break 	Disconnecter-fuse double break 	Switch-disconnector-fuse double break 
Fuse-switch single break 	Fuse-disconnector single break 	Fuse-switch disconnecter single break 
Switch-fuse double break 	Disconnecter-fuse double break 	Switch-disconnector-fuse double break 

A disconnecter is a mechanical device that fulfills the requirements specified for the isolation function in the open position, as specified in IEC 60947-1.

The purpose of an isolator is to cut off the supply from all or a discrete section of the installation by separating the installation or section from every source of electrical energy for safety reasons.

Load switches (or only “switches”) are mechanical switching devices capable of making, carrying and breaking currents under normal circuit conditions which may include specified operating overload conditions and also carrying for a specified time currents under specified abnormal circuit conditions such as those of short-circuit.

Switch Disconnecter Fuses have combined properties of load switches and disconnectors in addition to the protection offered by fuses.

Utilization Category of S-D-Fs & S-Ds

The Utilization Category of any equipment indicates the type of electrical load and duty cycle of the load; it is characterized by one or more of the following service conditions:

- Rated operated current
- Rated operated voltage
- Power factor
- Short circuit performance (making & breaking capacity)
- Selection of equipment

Product Standard	Utilization Category	Application
SDFs, Changeovers, SDs IS/IEC 60947 (Part 3)	20	Connecting and disconnecting under no-load
	21	Switching of Resistive loads
	22	Switching of mixed resistive and inductive loads
	23	Switching of motor or highly inductive load

Contains suffix: Category A (frequent) or Category B (infrequent) operation

Utilization Category is very important in defining:

1. Electrical & Mechanical life of the equipment.
2. Making & Breaking Capacity of the equipment.

Operational Performance as per standard:

Ie, (A)	Category A			Category B		
	w/o current	With current	Total	w/o current	With current	Total
0-100	8500	1500	10000	1700	300	2000
100-315	7000	1000	8000	1400	200	1600
315-630	4000	1000	5000	800	200	1000
Above 630	2500	500	3000	500	100	600

Category A demands **for 5 times more** electrical and mechanical life as compared to B

Utilization Category	Making Power Factor	Breaking Power Factor
AC-22	0.8	0.8
AC-23	0.65	0.65

All about switches

Making & Breaking Capacity as per standard:

Utilization Category	Making Capacity		Breaking Capacity	
	I /Ie	Cos Ø	I /Ie	Cos Ø
AC-22	3	0.65	3	0.65
AC-23 (0<Ie<100)	10	0.45	8	0.45
AC-23 (Ie>100)	10	0.35	8	0.35

AC-23 is a far stringent test as current is 3.33 times as that in AC-22.

Also, power factor in AC-23 is 0.45 (0.35 in higher ratings). Operating at stringent power factor in AC-23 implies that thermal performance of the switch would be superior in AC-22 installation.

Benefits of AC-23A Utilization Category

- The electrical and mechanical life of type A switches is 5 times as that of type B switches
- Testing for AC-23A ensures ruggedness
- AC-23A switches run cooler at lighter loads
- AC-23A switches work well in low power factor conditions

Utilization Category of FN Switches is AC-23A

FN offers you a unique series of Switch-Disconnecter-Fuse combining compactness with high performance & customer convenience.

Range covers ratings from 32 A to 800 A in 5 frame sizes catering to:

- ✓ 2P applications
- ✓ 3P applications
- ✓ TPN applications
- ✓ 4P/Switched Neutral applications
- ✓ DC application
- ✓ Higher voltage (690V AC) applications

Open
Execution

2P

TPN (With
*Isolable/Switched
Neutral Link)

4P



#DIN type
Fuse



#DIN type
Fuse



Bolted
type Fuse



#DIN type
Fuse

\$415V, 32A to 800A

Frame 1: FN 32/63 | Frame 2: FN 100/125/160

* Switched Neutral in case of FN 32/63

Upto 63A- Cylindrical fuses

\$ 690V and DC ratings indicated in Technical Specifications

Family

Special version
for Harsh
Environment

FN S-D-F with
corrosion protection
have been designed
for use in sulphur-rich
environments.

TPN



Bolted
type Fuse

Spacious Sheet Steel
Enclosure version

SDF in spacious Sheet Steel Enclosure:

Complete range of SDF is also available
in attractive powder coated sheet steel
enclosures.

**FN 32 / 63 in sheet steel enclosure
comes fitted with gland plate. Separate
cable gland boxes are not required.**

TPN

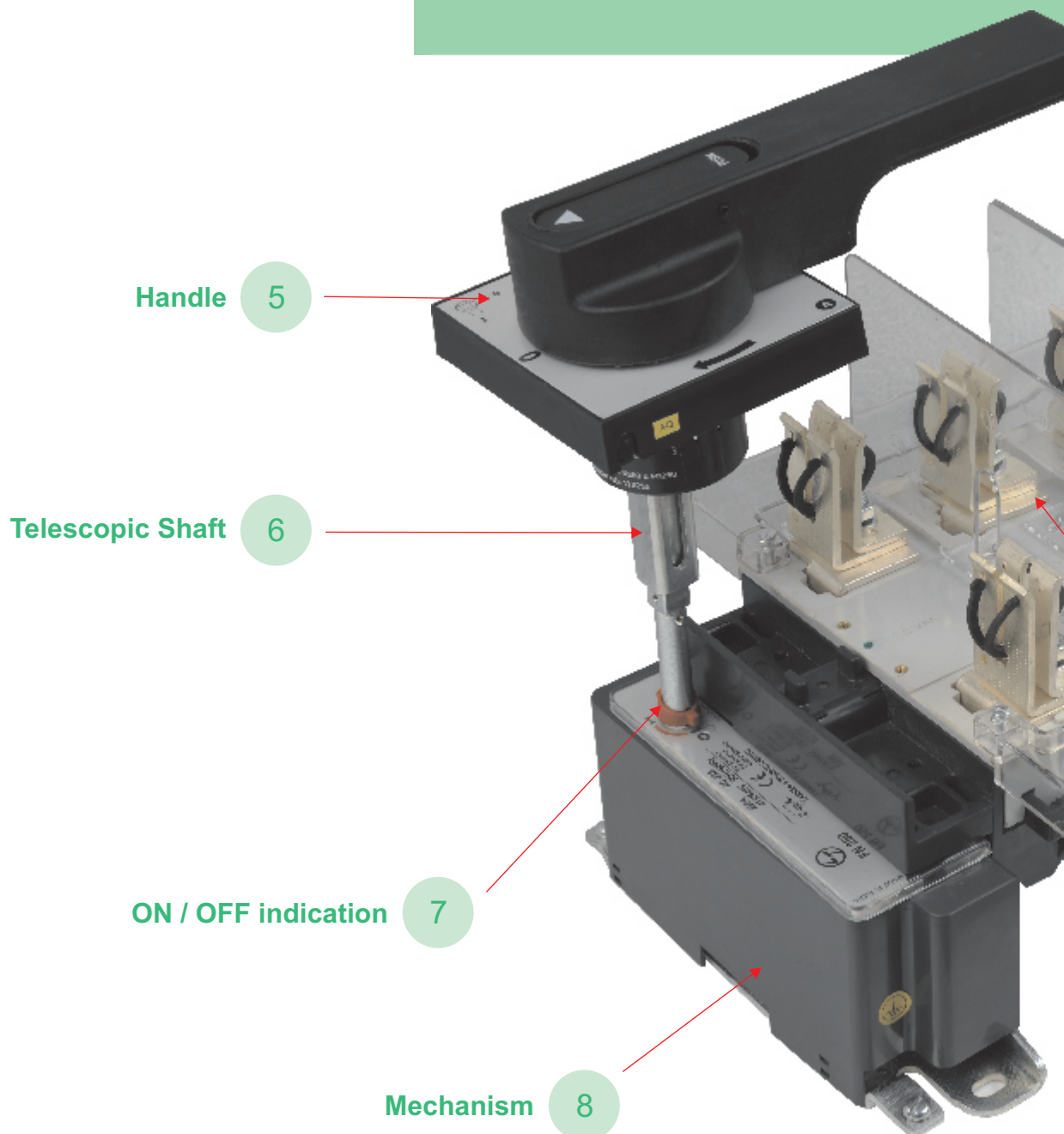


#DIN type
Fuse



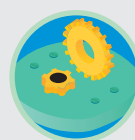
Switch Disconnecter
Version is also
available (2P, TPN, 4P)

Frame 3: FN 200/250 | Frame 4: FN 315/400 | Frame 5: FN 630/800



Safety

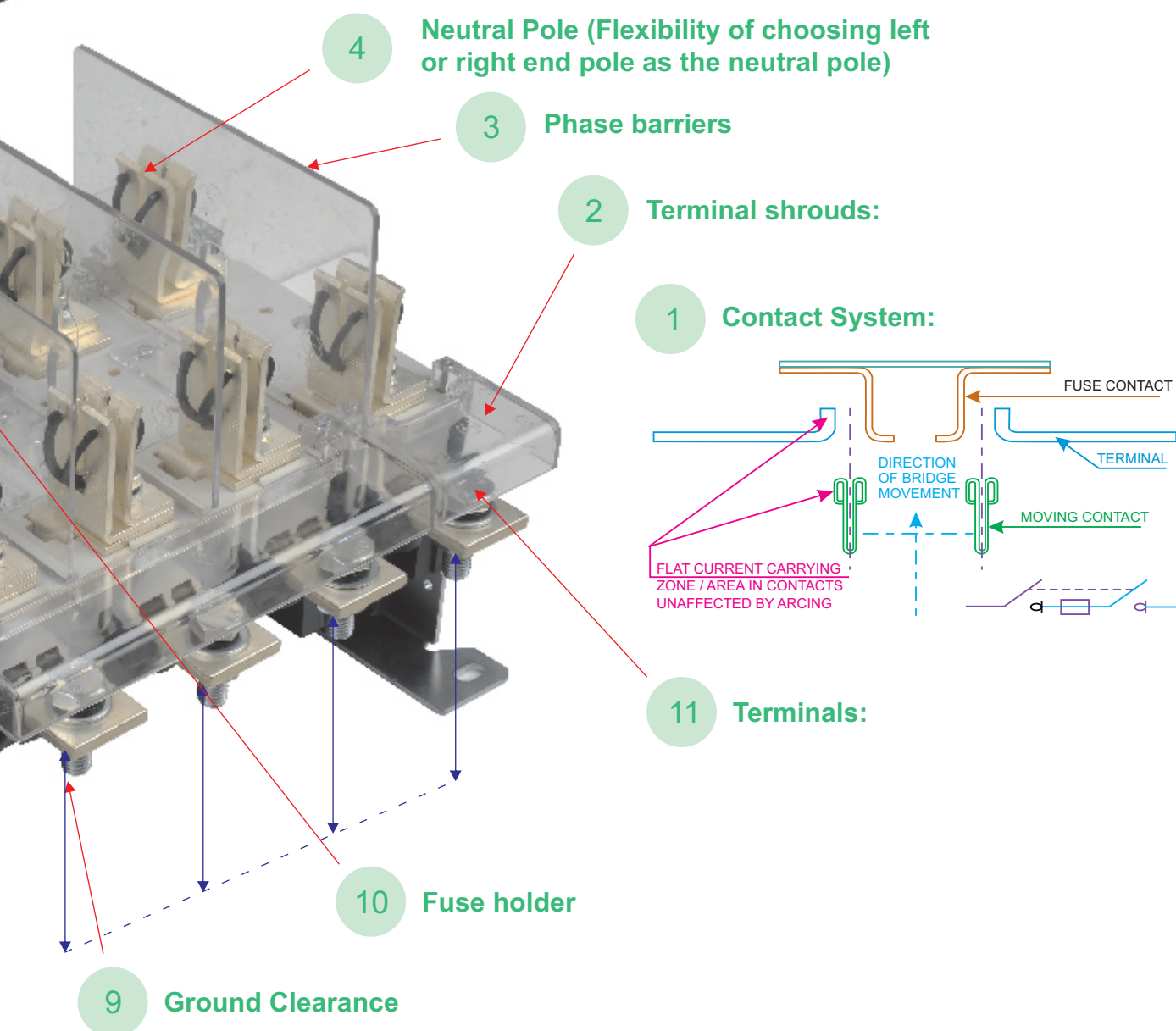
- Terminal shrouds
- Separate arcing / Current carrying zone
- High clearance & creepages
- Separate bridge for each pole
- Fuse stationary during switching operations & isolated from both sides
- Phase barriers
- Maximum ground clearance



Superior and reliable technology

- Electrodynamic compensation
- Quad break contact system enhances electrical life
- Full AC - 23 A rating for the complete range
- Quick make / Quick break / Positive break

Product Features



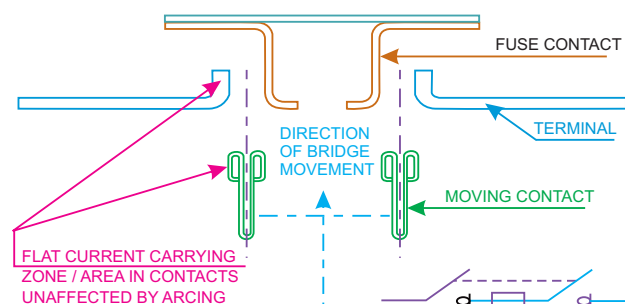
Convenience

- Light Weight and Low Operating Torque
- Compact design saves panel space
- Clear ON / OFF indicator
- Direct access to mounting & terminal screws
- Generous terminal capacity
- Suitable for vertical & horizontal orientation and can be mounted at any angle in a vertical plane
- No load-line bias

1

Contact System

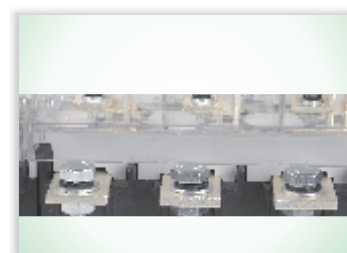
Contact system is QUAD BREAK. There are no. of parallel moving contacts per pole per break resulting in better arc quenching & more electrical life of contacts. Each pole has separate bridge carrying the moving contacts, achieving a high order of interphase separation & avoiding phase-phase flash over.



2

Terminal shrouds

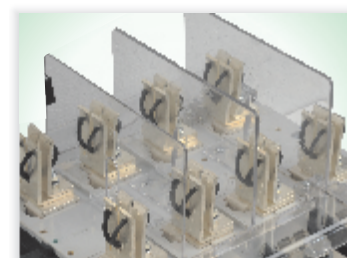
The terminals are shrouded for protection against phase-phase short circuit through an external conducting path and also for protection against accidental human contact with live terminals.



3

Phase barriers

Interphase barriers are provided to eliminate the possibility of Interphase short circuit.



4

Neutral Pole

Switch-Disconnecter-Fuse consists of an integral neutral, making the units suitable for 3 phase, 4 - wire application.

• TPN SDF

FN 32 / 63 has switched neutral while higher ratings have isolable neutral.

• 4P SDF

4P FN SDFs have 100% rated switched neutral with in-built neutral isolating link

Flexibility of choosing left or right end pole as the neutral pole

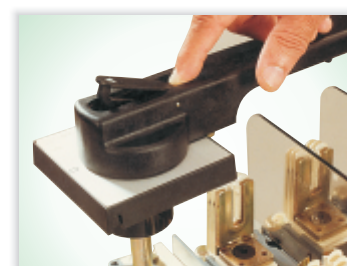


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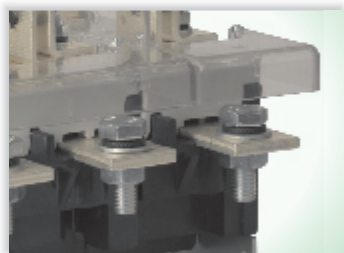
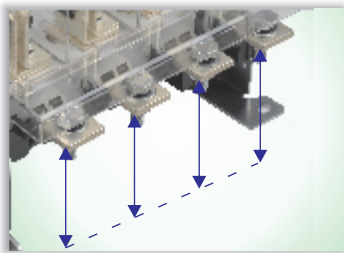
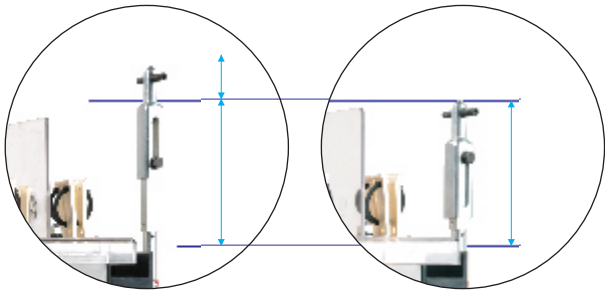
Handle

The handle coupling has the following user-friendly features:

- Easy fixing of handle on panel door by four screws.
- Door interlock for safety of operating personnel when switch is 'ON'. The interlock can be defeated if required.
- Built-in padlocking arrangement to lock the unit in either 'ON' or 'OFF' position.
- The handle coupling is suitable for a mismatch or $\pm 3\text{mm}$ in all directions.



Product Features



6

Telescopic Shaft

Shaft length can be varied and adjusted as per requirement during installation. This is possible because the telescopic shaft can be adjusted for stepless variable depth.

7

ON / OFF indication

Clear ON / OFF indication is provided on the switch (by a red pointer).

8

Mechanism

This mechanism is front operated quick-make/quick-break and independent of speed of operation.

9

Ground Clearance

Large ground clearance to eliminate possibility of phase-ground flash over.

10

Fuse holder

Fuses remain stationary during switching operation. Fuses are isolated from both sides. This offers safety to operating personnel while replacing fuses.

11

Terminals

To accommodate both Aluminum & Copper cables & busbars.

Technical Specifications

Frame Size		I			
Type Designation		Unit	FN 32	FN 63	FN 100
Reference standards		-			
Neutral in TPN SDF		-	Switchable	Switchable	Isolable
Rated operational voltage (Ue)		(V AC)	415	415	415
Rated insulation voltage (Ui)		(V AC)	690	690	690
Rated impulse withstand voltage (imp)		(kV AC)	8	8	8
Rated frequency		(Hz)	50 / 60	50 / 60	50 / 60
Service temperature		(°C)	-20 to 50	-20 to 50	-20 to 50
Pollution degree		-	3	3	3
Conventional enclosed thermal current, Ithe at 40 Deg C		(A)	32	63	100
Conventional free air thermal current, Ith at 40 Deg C		(A)	32	63	100
Rated operational current, Ie for AC 21A / AC 22A		(A)	32	63	100
Rated operational current, Ie for AC 23A		(A)	32	63	100
Rated breaking capacity (436 V, cosØ-0.35)		(A)	256	504	800
Rated making capacity (436 V, cosØ-0.35)		(A)	320	630	1000
Capacitor duty - 415 V 50 - 60 Hz		(kVAR)	12	23	36
Mechanical endurance		(operating cycles)	15000	15000	15000
Operating torque		(N-m)	4	4	4
Terminations					
Terminal capacity (main)		mm ²	35	35	95
Terminal capacity (neutral)		mm ²	35	35	50
Terminal screw		mm	M6 x 12	M6 x 12	M8 x 20
DC Rating for DC 22B					
Rated operational current, Ie at 220 V DC (2P in series)		(A)	32	63	100
Rated operational current, Ie at 440 V DC (3P in series)		(A)	32	63	100
AC Rating for 690 V AC Operational Voltage					
Rated operational current, Ie for AC-22B		(A)	32	63	63
Suitable L&T fuse					
DIN	Rated fused short circuit current	kA	80**	80**	100
	Rating	A / Type / Size	32 / HF / 14 x 51	63 / HF / 14 x 51	100 / HN / 000 & 00
BS	Rated fused short circuit current	kA	80	80	80
	Rating	A / Type / Size	32 / HQ / A1L	63 / HQ / A1L	100 / HQ / A3 & A4

*...Power factor = 0.45 as required in IEC 60947 -3

**...Suitable for cylindrical fuses

II		III		IV		V	
FN 125	FN 160	FN 200	FN 250	FN 315	FN 400	FN 630	FN 800
IEC 60947- 3, EN 60947- 3, IS/IEC 60947 - 3							
Isolable	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable
415	415	415	415	415	415	415	415
690	690	690	690	690	690	690	690
8	8	8	8	8	8	8	8
50 / 60	50 / 60	50 / 60	50 / 60	50 / 60	50 / 60	50 / 60	50 / 60
-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50
3	3	3	3	3	3	3	3
125	160	200	250	315	400	630	800
125	160	200	250	315	400	630	800
125	160	200	250	315	400	630	800
125	160	200	250	315	400	630	800
1000	1280	1600	2000	2520	3200	5040	6400
1250	1600	2000	2500	3150	4000	6300	8000
45	58	72	90	113	144	226	288
15000	15000	10000	10000	10000	10000	10000	10000
12	12	20	20	25	25	25	25
95	95	240	240	400	2 x 400	2 x 625	2 x 625
50	50	120	120	240	240	400	400
M8 x 20	M8 x 20	M10 x 20	M10 x 30	M10 x 30	M12 x 40	M16 x 50	M16 x 50
125	125	200	250	315	400	630	800
125	125	200	250	315	400	630	800
100	125	160	200	250	315	400	630
100	100	100	100	100	100	100	100
125 / HN / 000 & 00	160 / HN / 00	200 / HN / 0	250 / HN / 1	315 / HN / 1	400 / HN / 2	630 / HN / 3	800 / HN / 3
80	80	80	80	80	80	80	
125 / HQ / A4	125 / HQ / A4	200 / HQ / B2	250 / HQ / B2 & B3	315 / HQ / B3	400 / HQ / B4	630 / HQ / C2	

FN switch range offers a distinctive feature to mount S-D-F in different quadrants.
This feature aids mounting flexibility.
Handle coupling is as per IS 8623.

FN S-D-F operating quadrant chart (Seen from front of the door) In FN Switch universal mounting is achieved by Type A and Type B handle.

Type A : Supplied as standard with all Switches

Type B : Available as an accessory

Seen from front of the door

Sr. No.	Handle (OFF) Position	Operating Quadrant (hand)	Switch Orientation	Door Cut-out	Handle Coupling Type
1					B
2					A
3					A
4					B
5					B
6					A
7					A
8					B

Note : Arrow (←) indicates position of Interlock Defeat Key
Type A : supplied as standard with all S-D-Fs
Type B : supplied on request

Ordering Information

FN S-D-F Ordering Information

Operating Current Rating (A)	32	63	100	125
2P SDF with DIN type fuses	SK955940000	SK955950000	ST350860000	ST350870000
TPN SDF with DIN type fuses	SK955180000 SK957030000*	SK954210000 SK957030000*	SK955680000	SK950010000
4P SDF with DIN type fuses	SK955180000 SK957030000*	SK954210000 SK957030000*	SK904960000	SK904970000
TPN SDF with bolted type fuses	SK956530000	SK956510000	SK955700000	SK950090000
TPN SDF with bolted type fuses (suitable for HE)	SK901330000	SK901340000	-	SK900690000
TPN SDF in spacious SS enclosure	SK904830000	SK904840000	SK904850000	SK904860000

Operating Current Rating (A)	160	200	250	315
2P SDF with DIN type fuses	ST350880000	ST350890000	ST316740000	ST389300000
TPN SDF with DIN type fuses	SK957130000	SK954180000	SK956420000	SK954610000
4P SDF with DIN type fuses	SK904980000	SK904710000	SK904720000	SK904730000
TPN SDF with bolted type fuses	SK957140000	SK955880000	SK956820000	SK955900000
TPN SDF with bolted type fuses (suitable for HE)	SK901300000	SK904160000	SK904170000	SK901320000
TPN SDF in spacious SS enclosure	SK904870000	SK904880000	SK904890000	SK904900000

Operating Current Rating (A)	400	630	800
2P SDF with DIN type fuses	ST316760000	ST350900000	-
TPN SDF with DIN type fuses	SK954810000	SK955210000	SK956790000
4P SDF with DIN type fuses	SK904800000	SK904810000	SK904820000
TPN SDF with bolted type fuses	SK955910000	SK955920000	-
TPN SDF with bolted type fuses (suitable for HE)	SK900990000	SK901280000	-
TPN SDF in spacious SS enclosure	SK904910000	SK904920000	SK904930000

* 'CE' handle has door interlock facility without defeat feature

Wide range of spares & accessories are available for Switch-Disconnecter units

Type FN Spares & Accessories



Terminal Shroud

The terminals can be shrouded for protection against phase-short circuit through an external conducting path and against accidental human contact with live terminals.

FN SDF are now fitted with terminal shrouds on both input & load side.



Castell interlock

Switch-Disconnecter-Fuse units can be locked on OFF position with help of castell interlock. Castell interlock can also be used to interlock two SDF units. (Different variety of locks are available).



Handle coupling (type A & B)

Irrespective of the switch orientation (vertical or horizontal), operation in any of the four quadrants is possible by selecting right handle coupling (Refer Handle selection table).



Auxiliary contacts

1 NO + 1 NC auxiliary contact is available as an accessory. Also, 2NO + 2NC can be obtained by using additional 1NO+ 1NC This can be suitably wired in the control circuit.

- Rated operational current I_e (AC - 15) - 4 A
- Rated operational voltage U_e - 415 V



Fuse Puller

A fuse puller is provided to facilitate easy & safe removal of fuses.



Earthing Assembly

The site-mountable earthing assembly facilitates termination of 25 mm wide earthing bar

Spares & Accessories for FN Range - Ordering Information

Description	FN 32 / 63	FN 100/125/160	FN 200	FN 250	FN 315	FN 400	FN 630	FN 800
Terminal Shroud Kit	SK911900000	SK911370000	SK913350000		SK913460000		SK913470000	
Aux. Contact (1 NO + 1 NC)	SK913020000	SK913280000	SK913290000		SK913290000		SK913300000	
2nd Aux. Contact (1 NO + 1 NC)	SK906700000	SK906960000						
Handle Coupling (Type - A)	SK912570000	SK912580000	SK912580000		SK912590000		SK912590000	
Handle Coupling (Type - B)	SK912770000	SK912780000	SK912780000		SK912790000		SK912790000	
Handle Coupling (Type - CE)	SK913370000	Not Available						
Fuse Puller	SK911850000	SF901260000			SK912790000			
Castell Lock (Type A-Type D)	Not Available	SK003330000 - SK003360000			SK003450000 - SK003480000			
Earthing Assembly	-	CK903960000						

Ordering Suffix - 0000 for all.

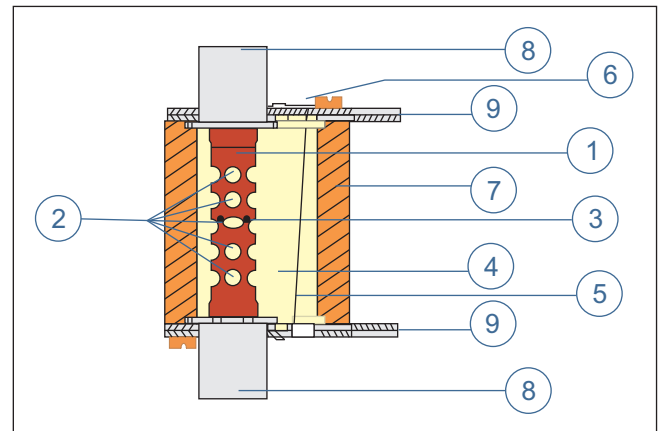
High Rupturing Capacity Fuse Link - Technical Note

Introduction:

A fuse is a piece of conducting element which is designed to carry rated current in normal conditions and breaks the circuit by rupturing/melting under overload or short circuit faults. Fuse-links are current sensitive devices.

Construction:

A HRC type fuse link typically consists of a fuse element welded in between the blade contacts and enclosed in an insulating tubular fuse body. The blade contacts are placed between cover plates with protruding gripping-lugs which engage with the fuse pulling handle for easy removal of the fuses. An indicating device - flap indicator is fixed to the face end and is released when the fuse blows.



- | | |
|-----------------------------|-------------------------------|
| 1 - Fuse Element | 6 - Indicator Button |
| 2 - Notches / constrictions | 7 - Fuse body |
| 3 - M-effect solder | 8 - Fuse blade contact/ knife |
| 4 - Filler | 9 - End Plate |
| 5 - Indicator Wire | |

- The fuse-element is the vital component of the HRC fuse which determines the overall performance of the fuse link. It is made of copper strip, and manufactured with utmost care and precision. Uniform strip thickness, good conductivity and a precise neck profile ensures low power dissipation. One peculiarity of the fuse element is presence of constrictions at regular intervals which heat up rapidly when abnormal/short circuit flows and start rupturing. The number of constrictions / notches in series is dependent on the recovery voltage (system voltage). Approximately one constriction per 90V is required.
- The insulation body is designed to withstand very high temperatures and internal pressure. It is made of high-quality ceramics and prevents the ejection of hot gases and liquid metal into the environment.
- The cover / end plates are provided with gripping lugs intended to be engaged with the standardized replacement handle (fuse pulling handle) for safe insertion and removal of the fuse-link. Along with the ceramic body, these form a pressure-resistant casing for the switching arc.
- Crystal quartz sand of high chemical and mineralogical purity (SiO_2 content $> 99.5\%$) is generally used. It is completely anhydrous as a result of heat-drying. Sand is important for achieving current limitation as it absorbs the arc energy and pressure generated. A defined grain size distribution and optimum packing density are essential for the performance. It effectively dissipates energy from the arc column by fusion.
- The indicating device allows quick detection of blown fuses.
- The solder is an element which has lower melting point and is chosen specially to react with the material of the fuse-element. It causes the time current characteristic to be shifted to lower melting currents thereby giving protection against overload condition. The quantity and placement of the solder element is crucial for its effective functioning.
- The blade contacts are designed to electrically and mechanically connect the fuse link with the fuse base/Switch Fuse Disconnecter. These are made of copper or copper alloy, the contact surface is generally silver-plated.

Fuse works on simple principle of heat generation (I^2t) by the amount of current flowing.

The constrictions on the cross-section of the fuse element are the weakest links in a HRC fuse. These are designed to heat up faster and reach higher temperatures than any other part of the fuse.

When an over current flows for a period long enough to cause the restrictions to melt, current paths breaks which results in development of an arc. Fuse elements made of pure copper are suitable for breaking high over current only (heat energy generated is I^2t) as the melting temperature is 1080°C .

In case, the melting temperature is reached at extremely slow rate, the fuse link becomes extremely heated, which may result in glowing contacts or destroying adjacent equipment components. Therefore, for fuse elements without any additional low-melting point material, there is always a called “prohibited” current range allowing the elements to be used only in partial range fuses for short-circuit protection.

Utilization Category of HRC fuse:

The area of application is designated by two letters, the first of which specifies the breaking current range and the second the utilization category.

Letter Code	Application (Characteristic)	Breaking Range
gG	General Purpose fuse-link mainly for conductor protection	Full range
gM	Motor circuit Protection	Full range
aM	Short - circuit Protection of motor circuits	Partial range

- 1.The letter “g” indicates full-range fuses that can continuously conduct currents at least up to their rated current I_n and that can break currents from the smallest melting current up to the rated breaking current.
- 2.The letter “a” signifies partial range fuses that can continuously conduct currents at least up to their rated current I_n and that can break currents above of a certain multiple of their rated current up to the rated breaking current. Generally, the breaking range begins at over four times the rated current and hence these are solely designed for short-circuit protection.

Our HF, HN and HG fuses have gG utilization category.

Overload disconnection

For disconnection of smaller over currents, a low-melting-point solder consisting usually of tin or tin alloy is applied on to the centre constriction wherein the fuse-element reaches its highest temperature. As the solder melts, the adjacent restrictions are dissolved and an arc is initiated which continues in both directions. At subsequent current zero, the arc is extinguished.

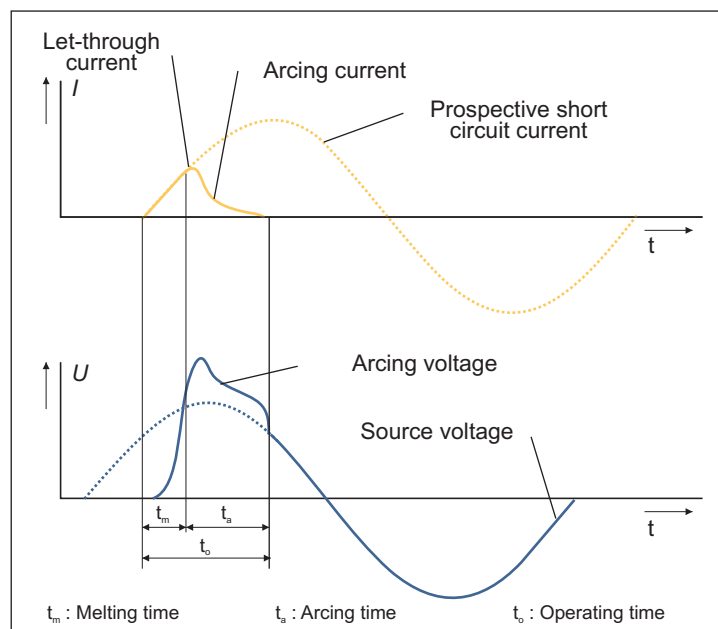
Intensive cooling of the arc channel caused by the melting quartz sand prevents re-ignition of the arc when the recovery voltage appears. In the arcing area a non-conductive mixture composed of fuse-element metal, solder and quartz is formed. Due to its appearance, it is also called “fulgurite caterpillar”.

At very high currents, all constrictions melt almost simultaneously, thereby initiating development of several partial arcs depending on the number of constrictions and forming a fulgurite uniformly extended over the whole length of the fuse-element which is typical for short-circuit interruptions.

Current-limiting short-circuit disconnection

At very high currents, like caused by short circuits, all constrictions heat up simultaneously at a speedy rate and the fuse element starts evaporating.

If the sand is packed too tightly packed with minute dust particles, extreme high pressure is built inside the fuse which can cause bursting of the fuse body. If the interspatial volume between the grains is too large, the arc can extend up to the inside ceramic surface of the fuse body or the end plates and cause damage the fuse body. Properly graded and carefully prepared sand will intensively cool the arc due to its energy absorbing ability, with the result that when the arcing voltage exceeds the supply voltage, the current is already terminated before natural zero of a 50 / 60 Hz alternative current. The peak value of the prospective short-circuit current is not reached at all.



Therefore, its current-limiting effect is one of the most valuable properties of the fuse, making it superior to any other over current protection device. Short-circuit usually has a very high first peak value known as impulse short-circuit current. Its magnetic force effect causes extraordinary stress to the current-carrying conductors, related clamps and insulation. Using current-limiting fuses help in keeping magnetic short-circuit forces at a low level and allows to easily control them.

Current-limiting fuses are designed to significantly limit not only the maximum current, but also the let-through energy, expressed in I^2t values, which occurs, for example, in the case of an arc fault, where a destructive energy is released at the fault location.

Thus, current limitation is synonymous with limitation of damage and risk to personnel working in live condition.

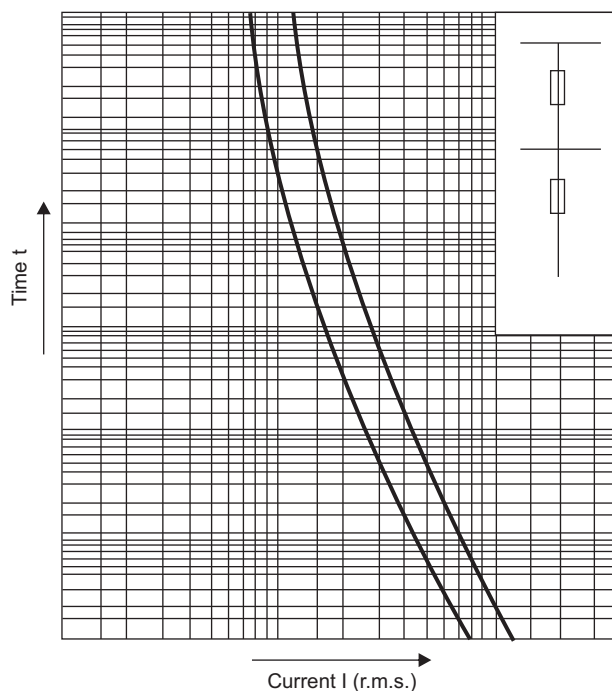
Current limitation & Selectivity of fuse as Short circuit protection device

In buildings and industrial plants, radial distribution networks are the norm. In radial distribution systems there are several protective devices in series, usually with decreasing rated currents from the supply end to the load end. While the operational currents decrease from the supply end to the load end, in the event of a short circuit the same fault current will flow through all the protective devices connected in series. By cascading of the trip characteristics it must be ensured that only the respective protective device that is closest to the location of the fault trips and hence the fault is selectively limited to the smallest possible part of the installation.

The basic prerequisite for selectivity of protective devices connected in series is that the trip characteristic of the downstream (closer to the load) protective device is faster than that of the upstream device. Special attention should be paid to the area of high over currents, where the effects of current limitation and breaking times are significant.

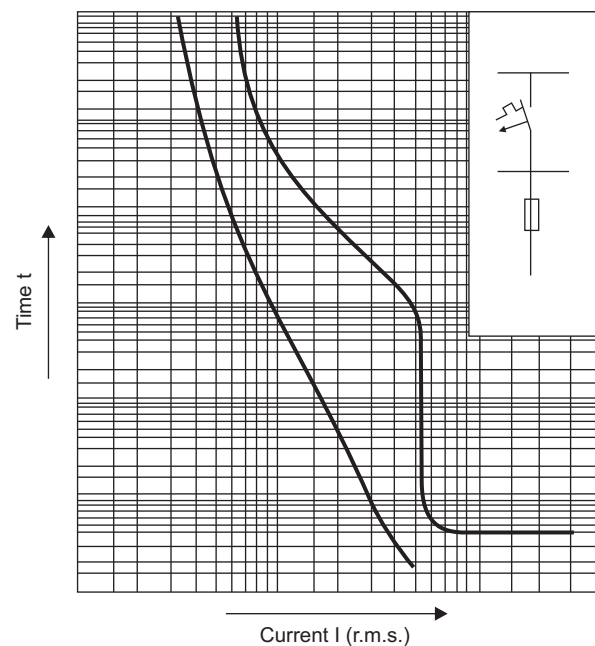
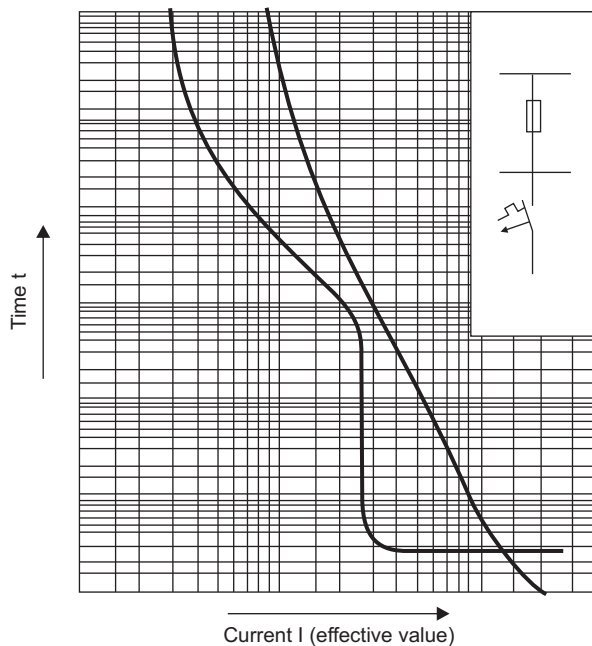
This Cascading & selectivity for the fuses is very simple because of the similarity in the characteristics throughout the range & constant characteristics for complete life of fuse.

Connection of fuses in series



Fuses connected in series act selectively if their time current-characteristic curves have sufficient spacing and their tolerance bands do not touch. At high short-circuit currents the melting I^2t value of the upstream fuse must be larger than the breaking I^2t value (melting and clearing time) of the smaller downstream fuse. This is usually the case if their rated currents differ by a factor of 1.6 or more

HRC Fuses



Connection of fuse & circuit breaker in series

1. Circuit breaker 2. Fuse

When fuse is installed as a downstream device, co-ordination between the tripping range of the short-circuit release of the circuit breaker and cut of current of the fuse can be seamlessly achieved as the short circuit currents are interrupted instantaneously by the fuse.

L&T HRC fuses Power loss data:

Size	Rating	Permitted power loss IS/IEC standard) W	Rated Power loss (W) HN fuse link	% saving in electricity consumed
000	100	7.5	7	7%
0	160	16	12.7	21%
1	250	23	17.3	25%
2	400	34	24.9	27%
3	630	48	42.2	12%

Get the FusEdvantage!

- Let-through energy value of fuse is extremely low compared to circuit breaker
- Low let-through energy leads to low stresses to the downstream protection devices & equipment
- Optimal cable size & contactor rating in case of type two co-ordinations due to low I^2t value.
- Low power loss leads to low running cost & minimum heating.

HRC Fuses - Cylindrical

Fuse Links Type HF

(Fuse links with cylindrical contact caps)

- Conforms to IEC 60269-2, IS 13703-2
- Low watt loss - Saves power
- Low let through energy
- High breaking capacity - 80 kA
- Rated voltage - 415 V
- Instant fault indication through red pop up indicator
- Lower power loss in our fuses result in cooler running of associated products



Ordering Details

Size	Fuse Rating (A)	Cat. Nos.	Rated Watt Loss
14 x 51	2	SF90144	0.6
	4	SF90145	0.6
	6	SF90146	1.1
	8	SF90147	1.2
	10	SF90148	1.0
	16	SF90150	2.4
	20	SF90151	2.4
	25	SF90152	3.2
	32	SF90142	5.0
	40	SF90143	5.0
	50	SF90158	5.0
	63	SF90159	7.4

Fuse-pulling handle should be used for safe and easy removal of fuse links
 Suitable fuse - pulling handle for type HF : SK91185

HRC Fuses - Blade / Knife type

Fuse Links Type HN

(Fuse links with blade contacts)

- Conforms to IEC 60269-2, IS 13703-2
- Low watt loss - Saves power
- Cooler running of associated products
- Low let through energy
- High breaking capacity - 100 kA
- Instant fault indication
- Rated voltage - 415 V



Size of the Fuse Link	Rating (A)	Cat. Nos.	Rated Watt Loss	Watt Loss Limits as per IS 13703
Size 000	63	SF94940	5.3	100 Amp, Fuse-7.5 W
	80	SF94941	6.2	
	100	SF94942	7	
	125	SF94946	8.5	
Size 00	63	SF94027	5.7	100 Amp, Fuse-7.5 W
	80	SF94028	6.9	
	100	SF94029	7.5	
	125	SF94030	9.8	
	160	SF94939	12	
Size 0	80	SF94128	8.3	160 Amp, Fuse-16 W
	100	SF94129	9.1	
	125	SF94130	11.3	
	160	SF94131	12.7	
	200	SF94132	14.5	
Size 1	125	SF94230	10.3	250 Amp, Fuse-23 W
	160	SF94231	12.3	
	200	SF94232	14.3	
	250	SF94233	17.3	
	315	SF94234	25.5	
Size 2	200	SF94332	14.1	400 Amp, Fuse-34 W
	250	SF94333	16.9	
	315	SF94334	20.2	
	400	SF94335	24.9	
Size 3	315	SF94434	20.5	630 Amp, Fuse-48 W
	400	SF94435	26.7	
	500	SF94436	36.1	
	630	SF94437	42.2	
	800	SF94938	48	

Fuse-pulling handle should be used for safe and easy removal of fuse links
 Suitable fuse - pulling handle for type HN : SF90126

Fuse Links Type HG and HQ (Fuse links for bolted connections)

- Conforms to IEC60269 / Is13703
- Low watt loss
- Low let through energy
- High breaking capacity - 80kA
- Rated voltage - 415V

Type HQ & Type HG

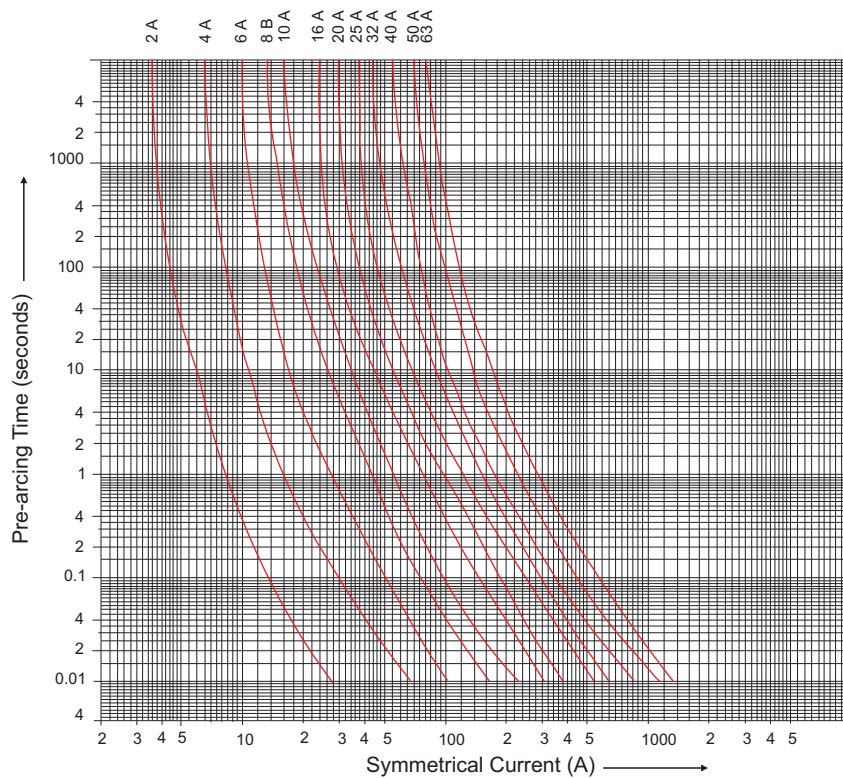
Size of the Fuse	Rating (A)	Cat. Nos.	Rated Watt Loss
F1	2	ST30725	0.3
	4	ST30726	0.5
	6	ST30727	1.2
	10	ST30728	1.4
	16	ST30729	1.8
	20	ST30730	2.2
	25	ST30731	2.9
	32	ST30732	3.0
A1L	20	ST34527	2.4
	25	ST34528	3.1
	32	ST34529	3.4
	50	ST35827	4.0
	63	ST35828	4.7
A2	4	ST30747	0.8
	6	ST30748	1.4
	10	ST30749	1.5
	16	ST30750	2.0
	20	ST30751	2.8
	25	ST30752	3.8
	32	ST30753	4.4
A3	35	ST30759	4.5
	50	ST30760	6.2
	63	ST30761	6.8
A4	80	ST30767	9.1
	100	ST30768	9.5
	125	ST30769	14
	160	ST35829	-
B1	80	ST30774	9.2
	100	ST30775	10.5
	125	ST30776	16.0
B2	125	ST30777	15.0
	160	ST30778	19.5
	200	ST30779	20.5
B3	250	ST30781	28
	315	ST30782	32
B4	355	ST30783	34
	400	ST30784	38
C2	400	ST30785	38
	500	ST30786	50
	630	ST30787	55



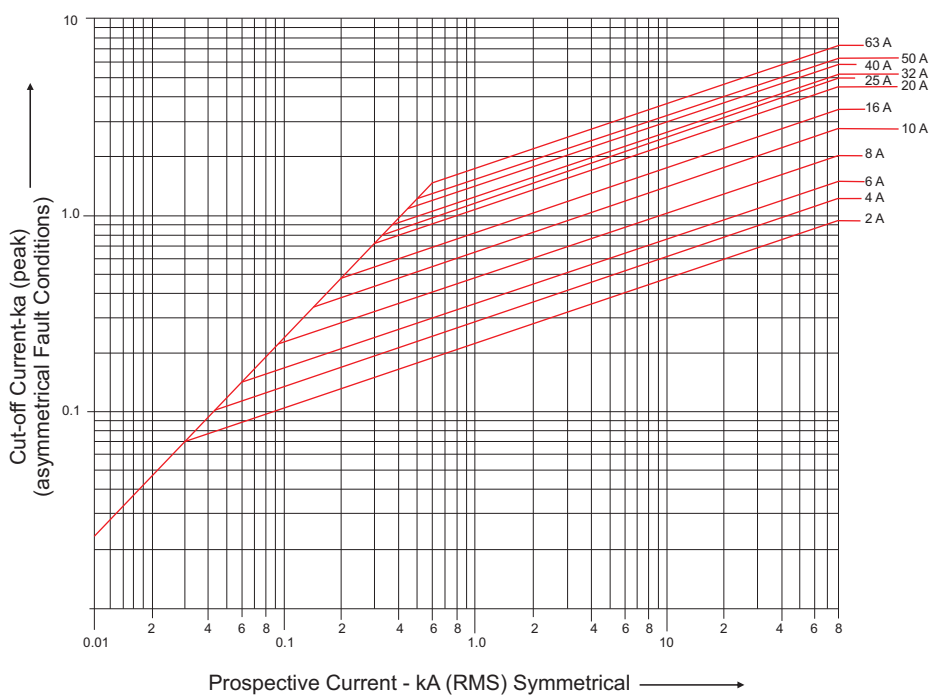
Characteristic Curves

HRC Fuse-link Type HF

Time-Current Characteristics

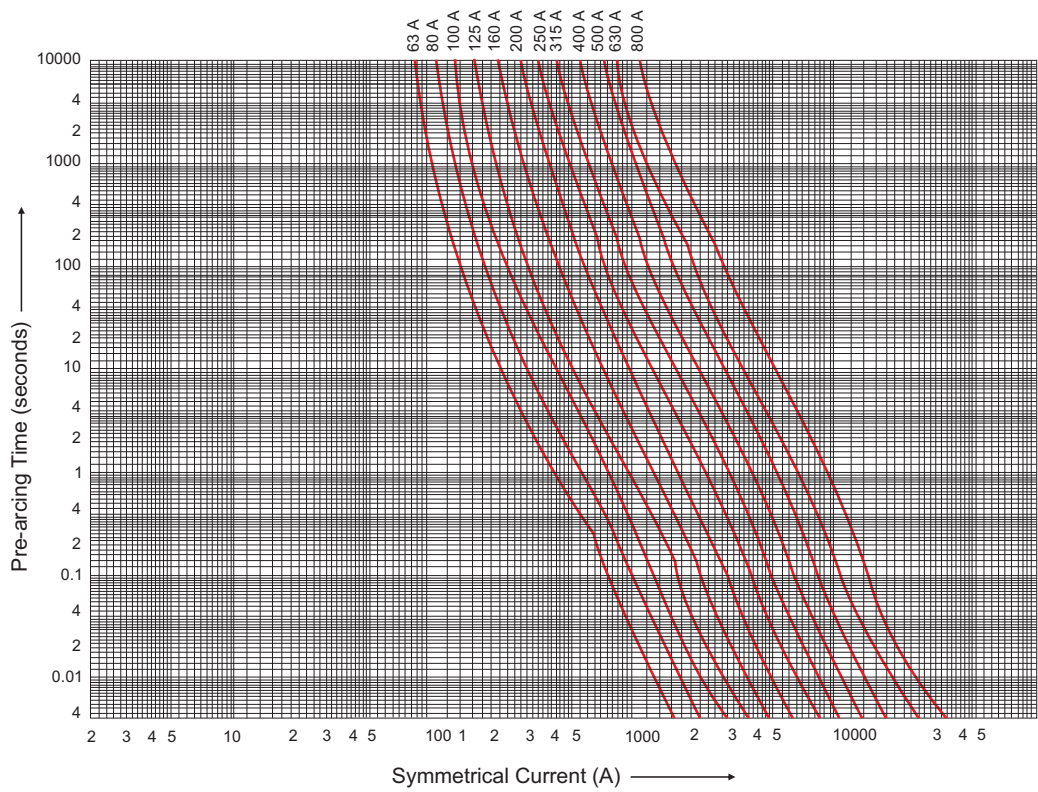


Cut-off Current Characteristics

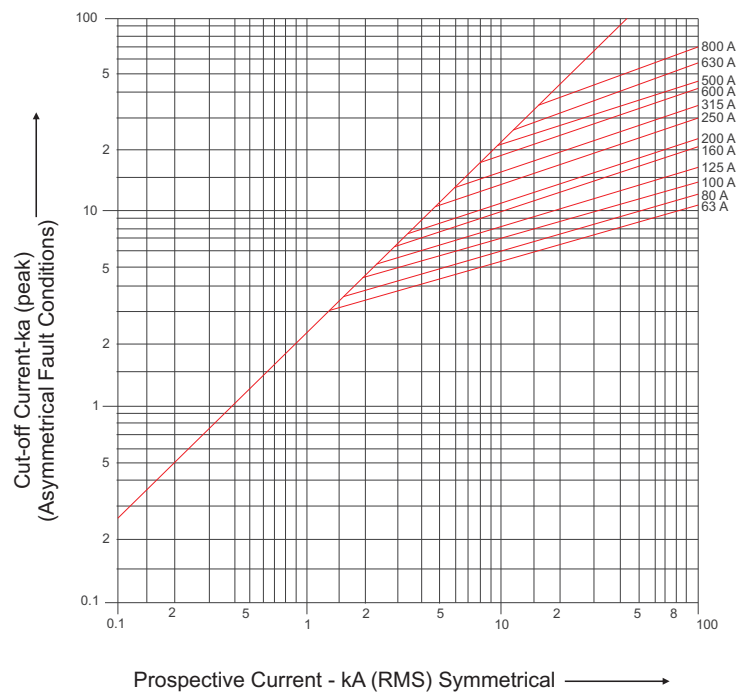


Characteristic Curves

HRC Fuse-link Type HN Time-Current Characteristics



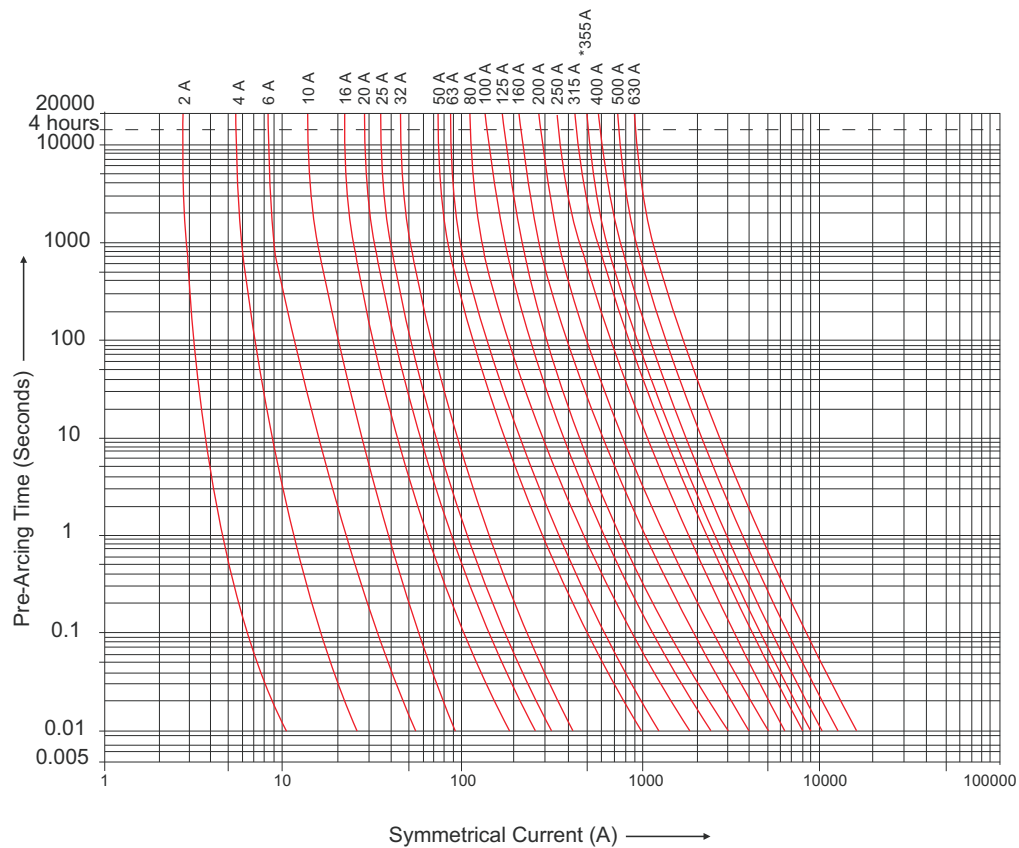
Cut-off Current Characteristics



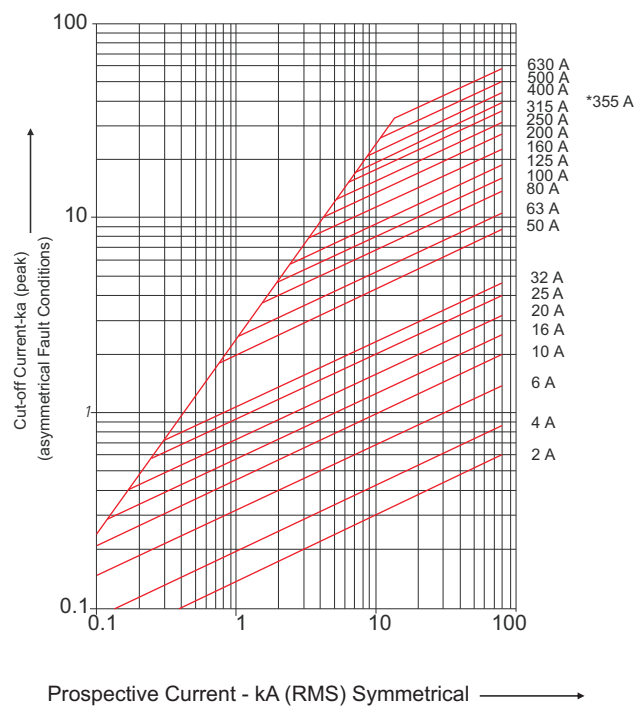
Characteristic Curves

HRC Fuse-links Type HQ

Time-Current Characteristics



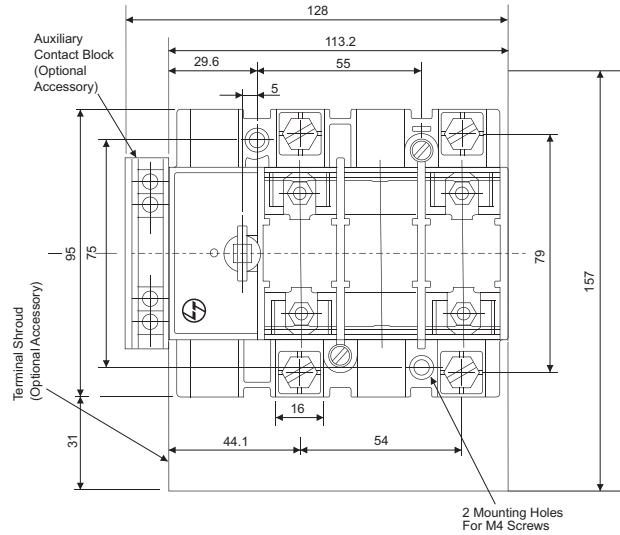
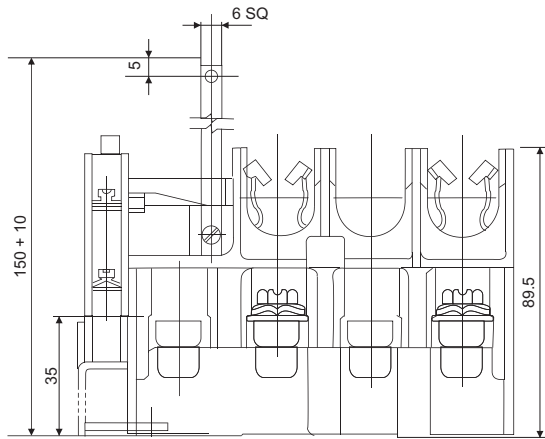
Cut-off Current Characteristics



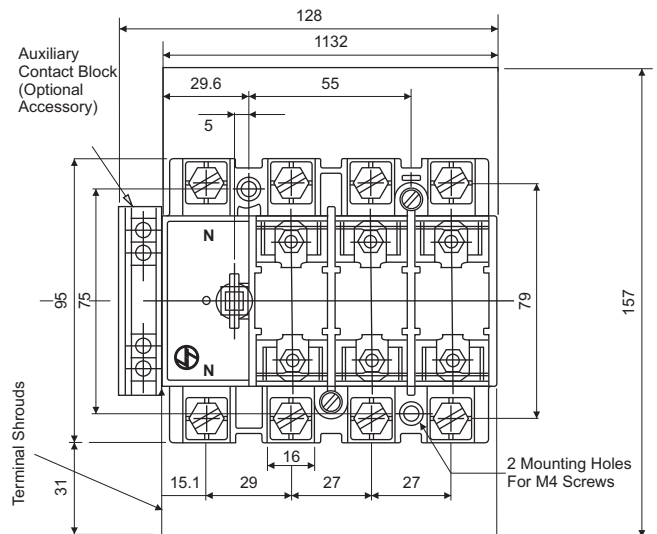
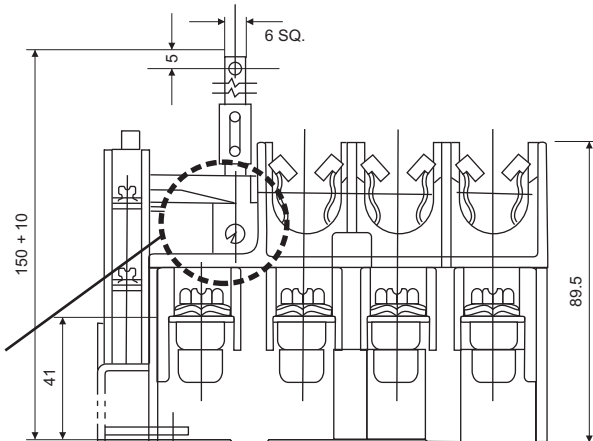
Overall Dimensions

Switch-Disconnecter-Fuse (suitable for DIN type fuses)

SDF - FN 32 / 63 2P



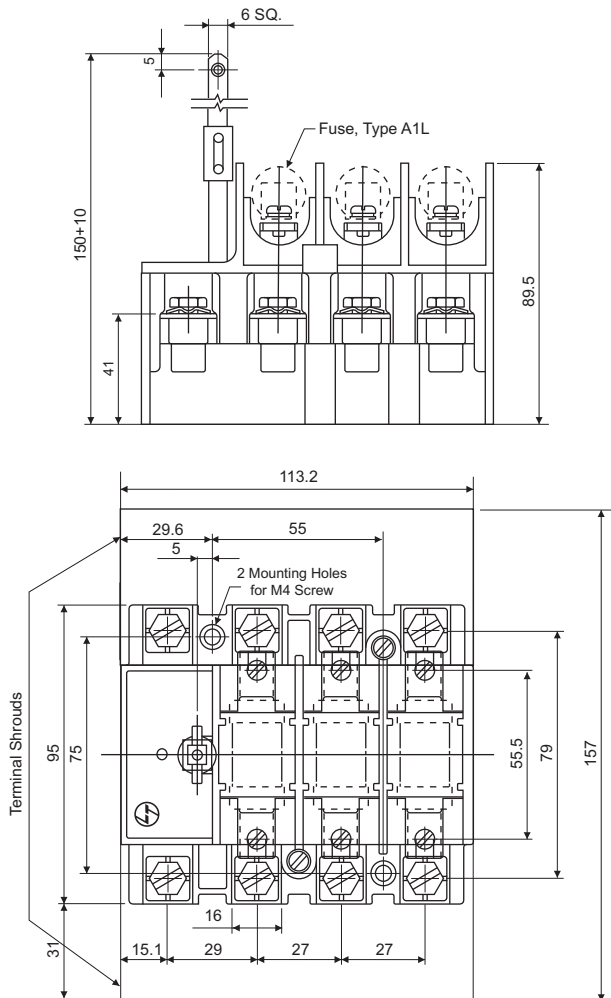
SDF - FN 32 / 63 TPN



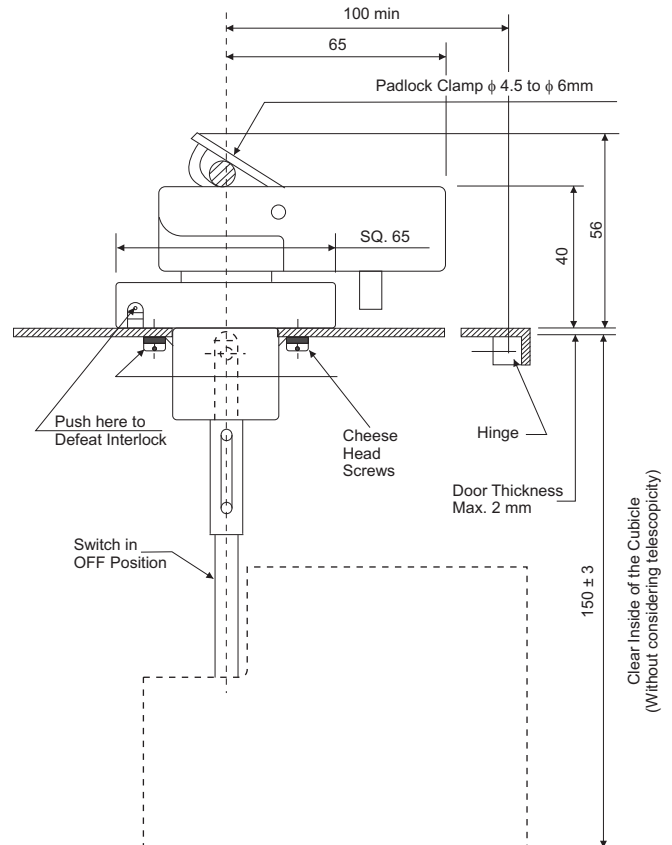
Overall Dimensions

Switch-Disconnecter-Fuse (suitable for Bolted type fuses)

SDF-FN 32/63 TPN

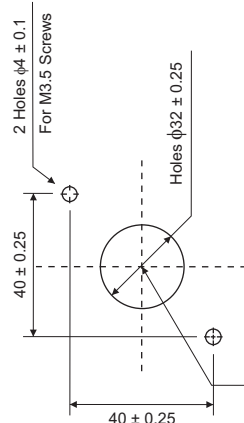


Assembly of Handle Coupling on Door - FN 32 / 63

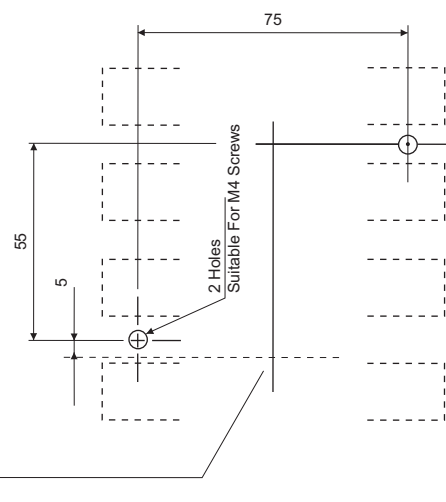


Drilling details FN 32 / 63

Drilling details on door for mounting handle coupling seen from front of the door



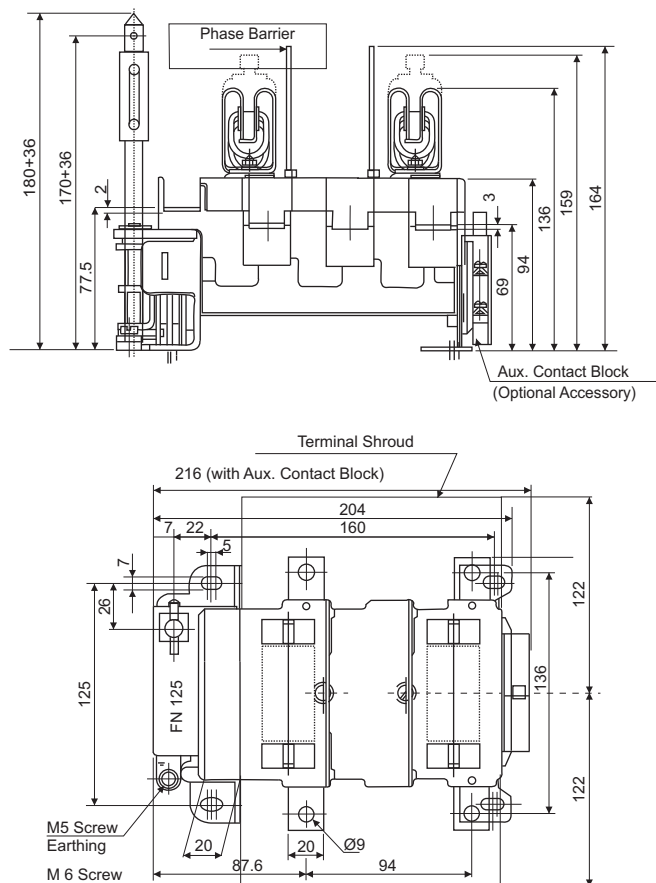
Drilling details on base plate for mounting switch seen from front of the door



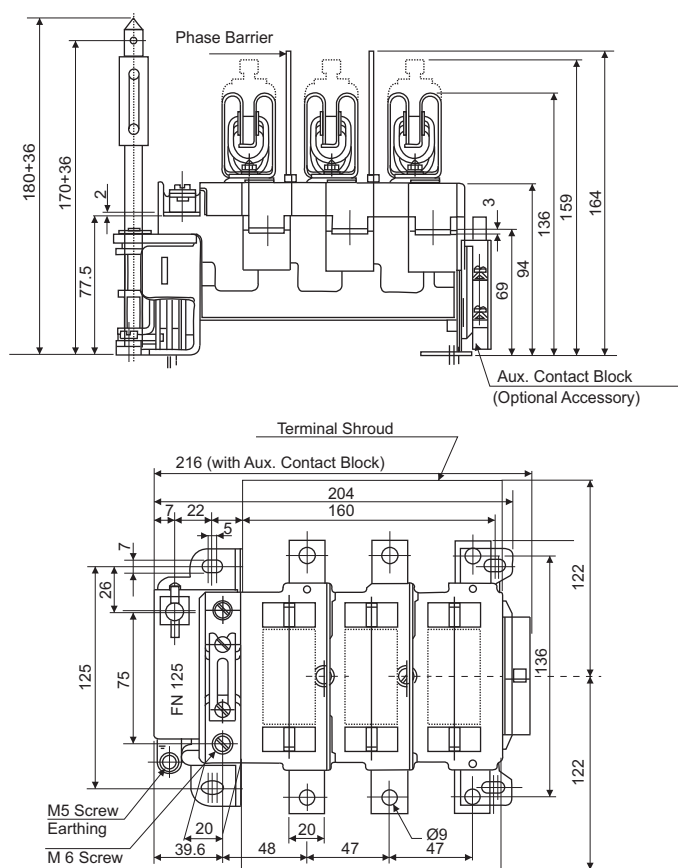
Note : All dimensions are in mm.

Switch-Disconnecter-Fuse (suitable for DIN type fuses)

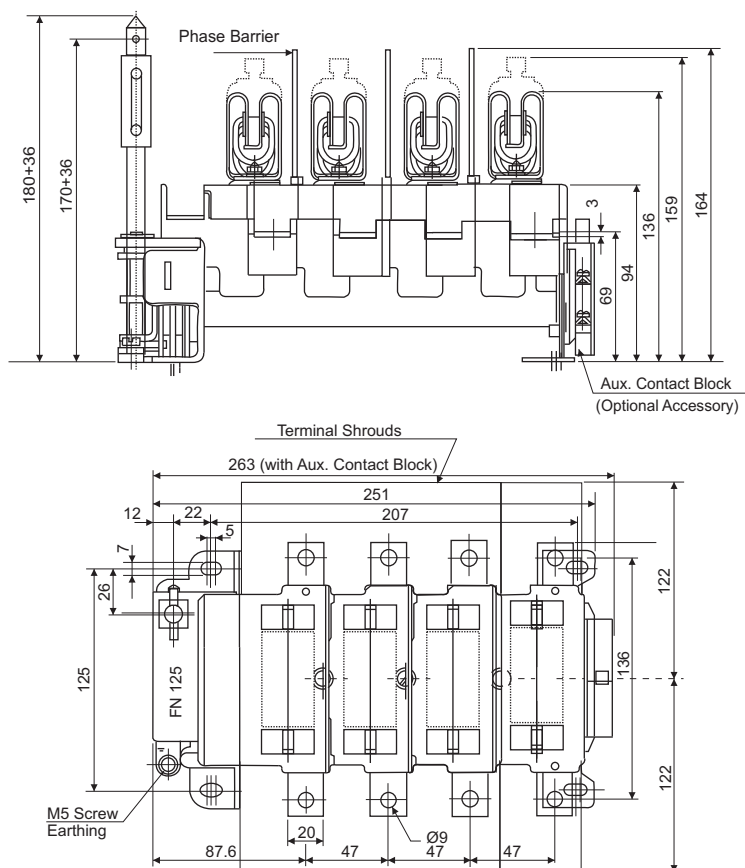
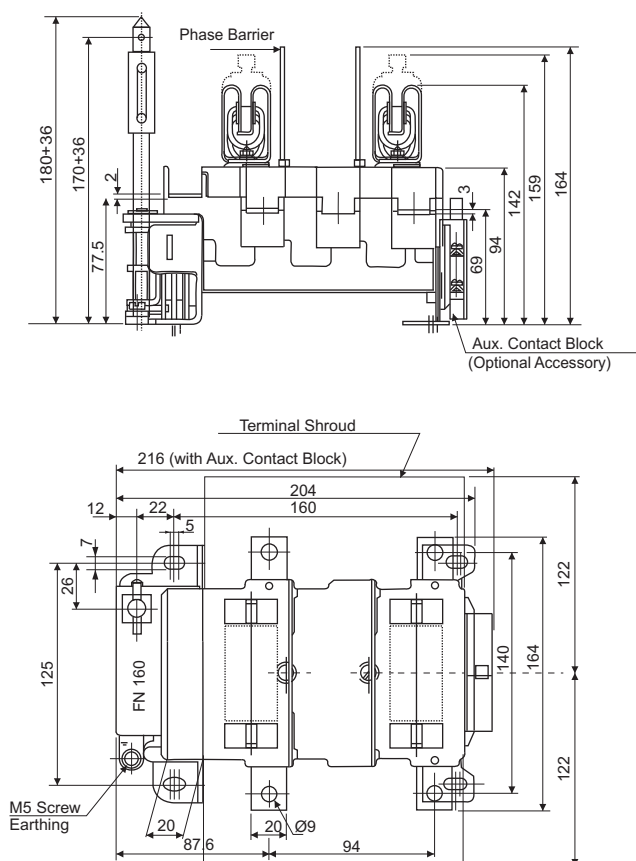
SDF - FN 100 / 125 2P



SDF - FN 100 / 125 TPN

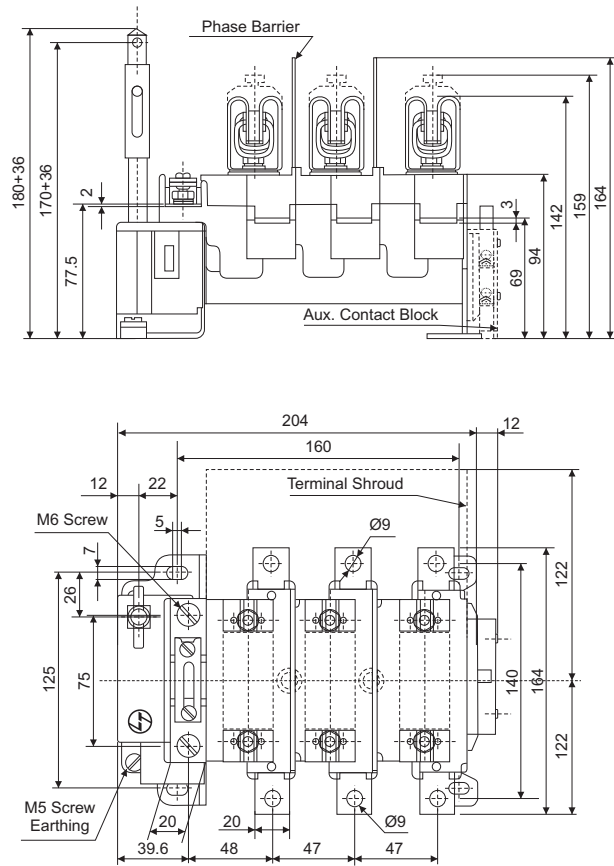


SDF - FN 100 / 125 4P

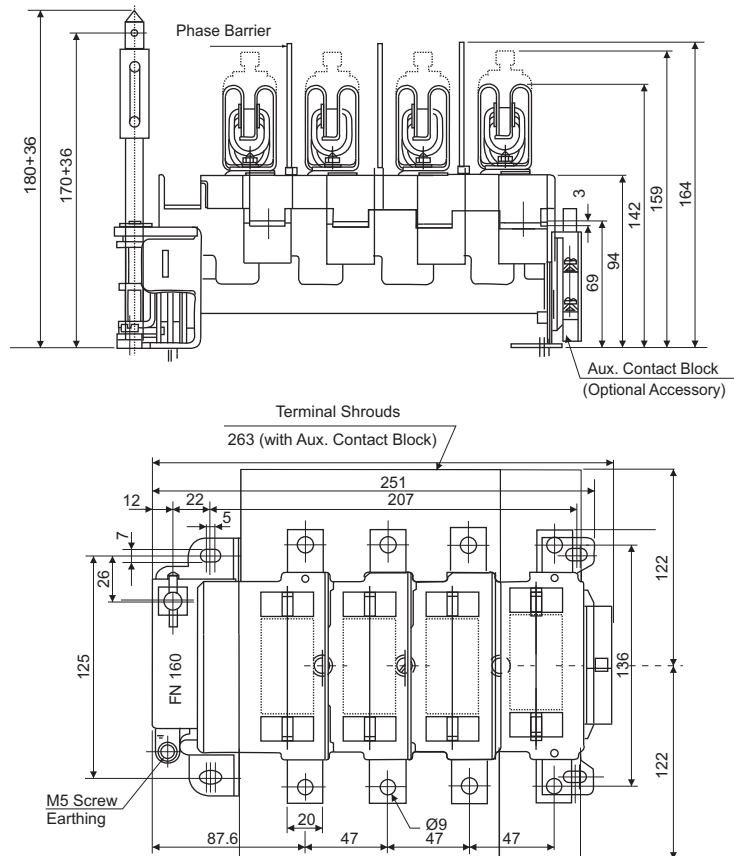
Switch-Disconnecter-Fuse (suitable for DIN type fuses)
SDF - FN 160 2P

Note : All dimensions are in mm.

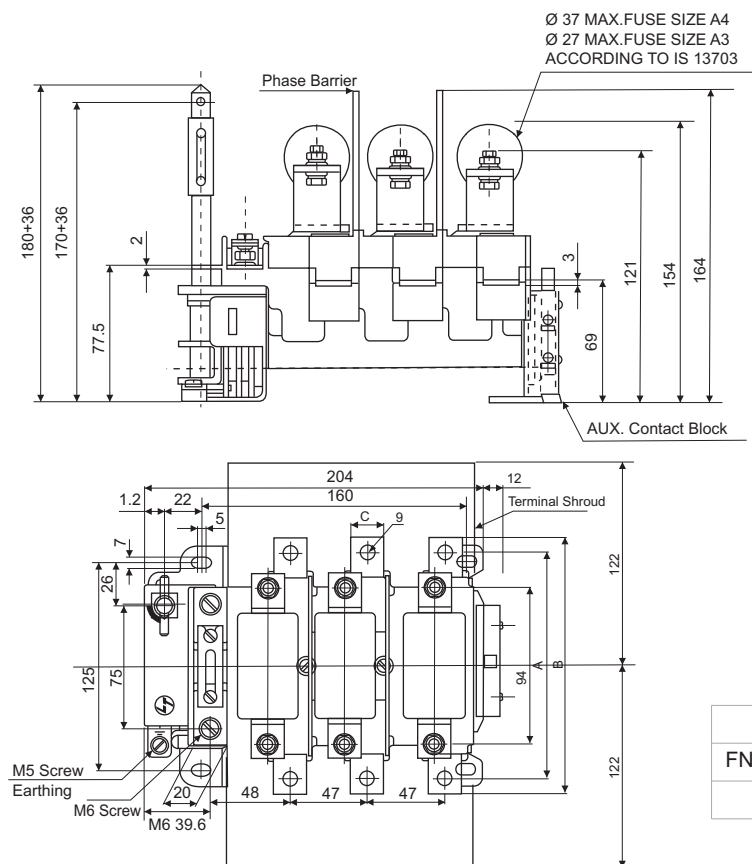
SDF - FN 160 TPN



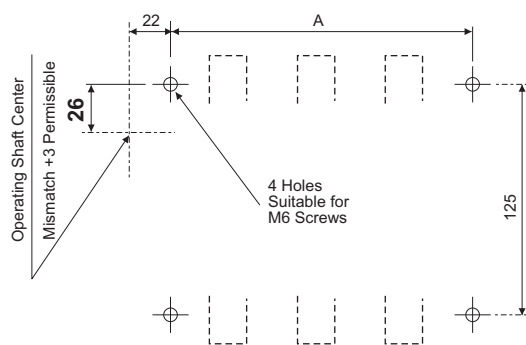
SDF - FN 160 4P



Switch-Disconnecter-Fuse (suitable for BOLTED type fuses) SDF - FN100/125/160 TPN

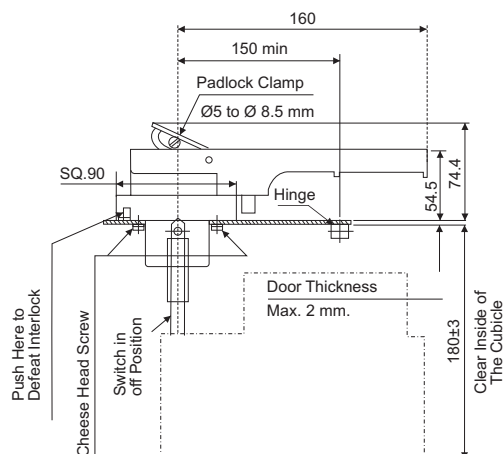


Drilling details on Door FN 100/125/160



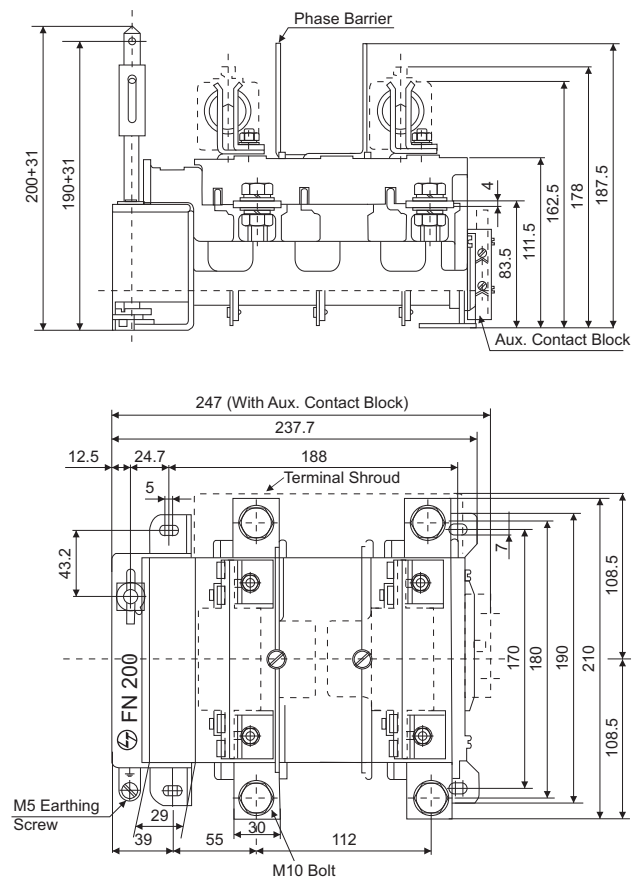
Dimensions	For 2P & 3P Switches	For 4P Switches
A	160	207

Assembly of Handle Coupling on Door FN 100 / 125 / 160

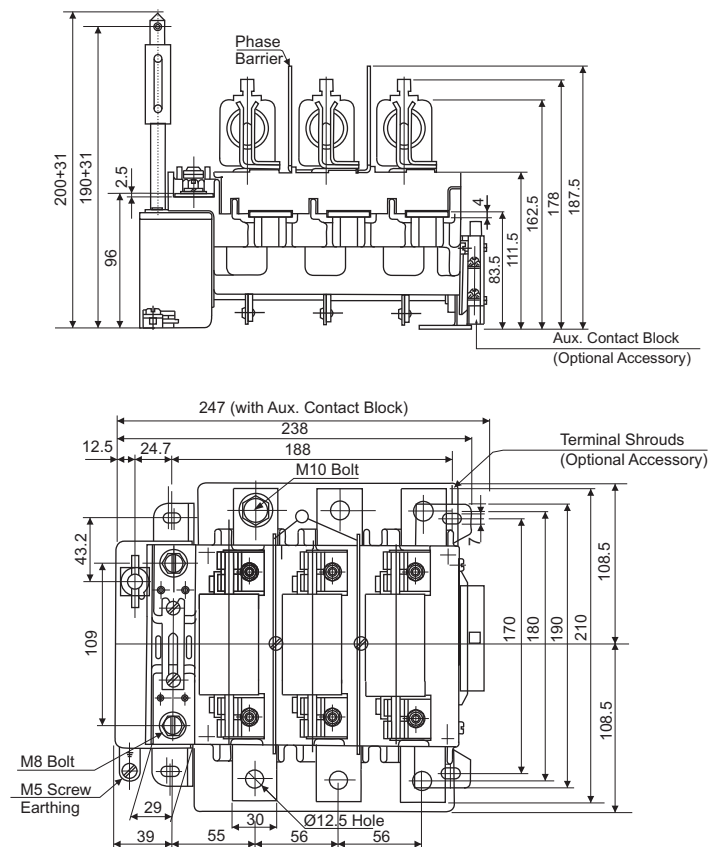


Note : All dimensions are in mm.

Switch-Disconnecter-Fuse (suitable for DIN type fuses)

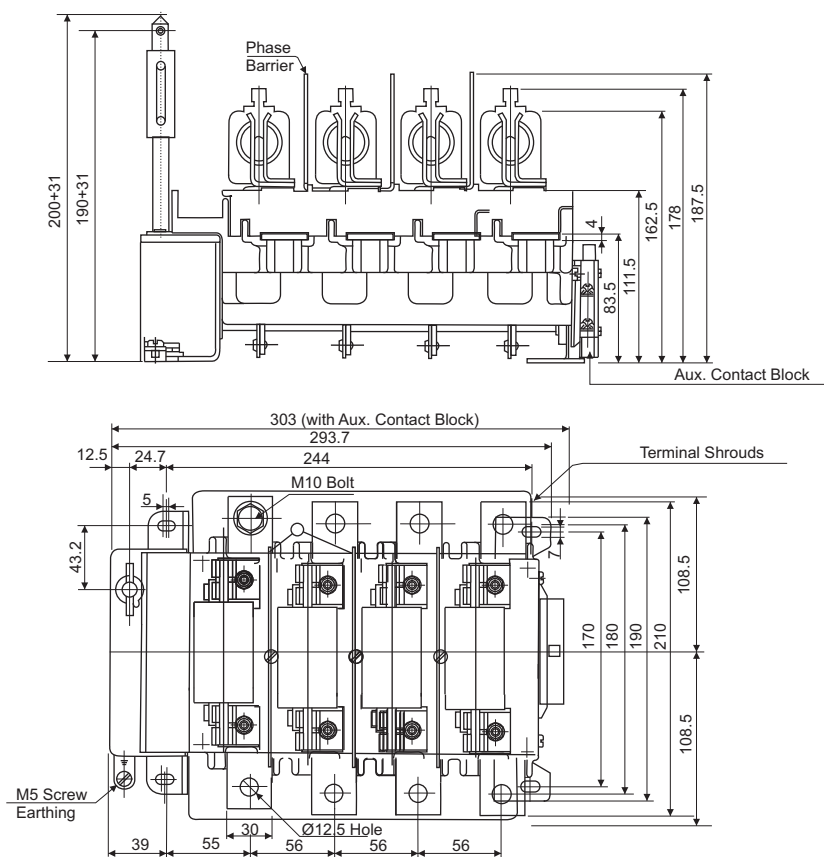


SDF - FN 200 TPN

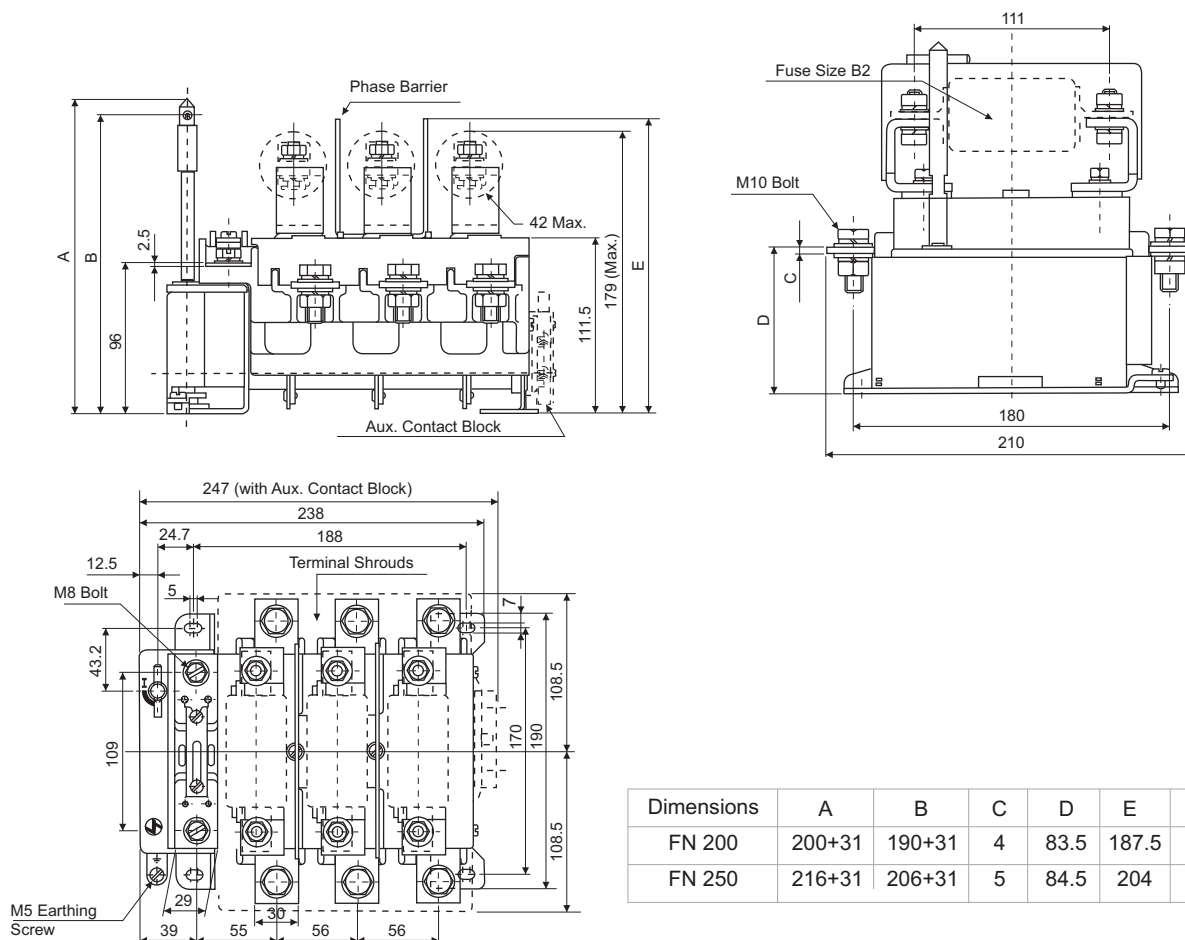


Note : All dimensions are in mm.

SDF - FN 200 4P



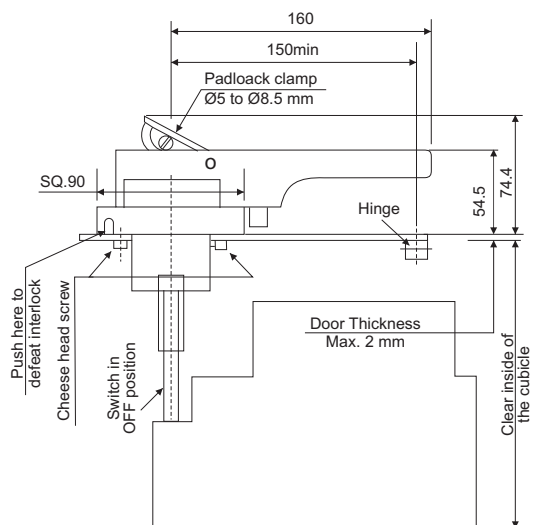
Switch-Disconnecter-Fuse (suitable for BOLTED type fuses) SDF - FN 200 / 250 TPN



Dimensions	A	B	C	D	E	Fuse
FN 200	200+31	190+31	4	83.5	187.5	200A
FN 250	216+31	206+31	5	84.5	204	250A

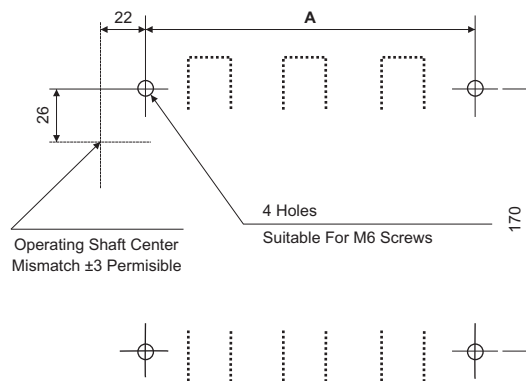
Note : All dimensions are in mm.

Assembly of handle coupling on door

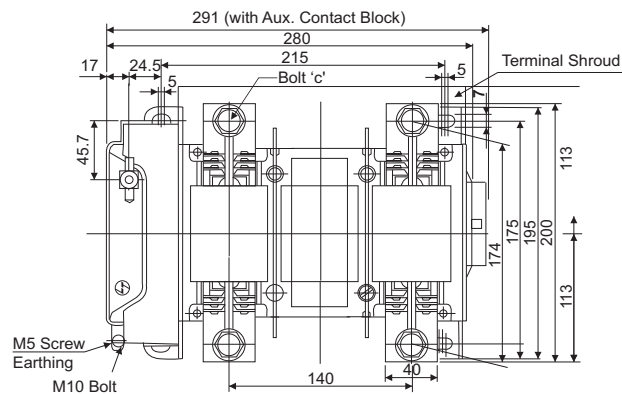
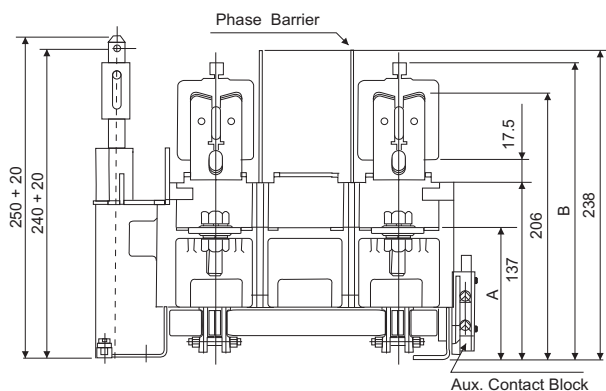


Dimensions	FN 200	FN 250
A	200	216

Drilling details on base plate for mounting switch seen from front of the door

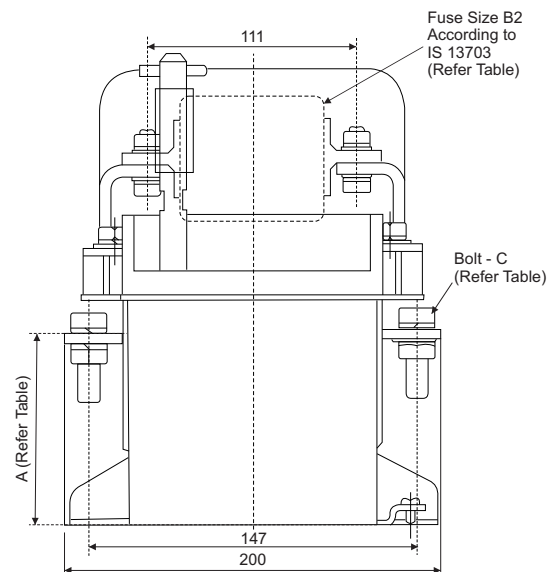


Switch-Disconnecter-Fuse (suitable for DIN type fuses) SDF - 315 / 400 2P



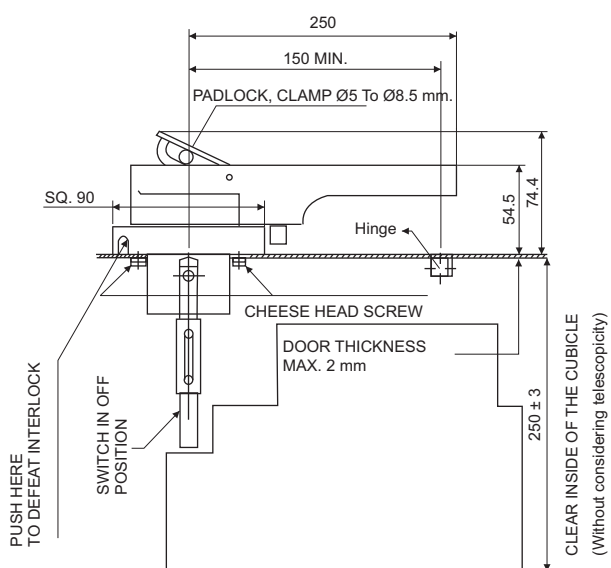
Dimensions	A	B	C
FN 315	103	220	M10
FN 400	102	228	M12

Note : All dimensions are in mm.



Rating	E
FN 315/250H	195
FN 400	235

Drilling details on door for mounting handle coupling
Seen from front of the door

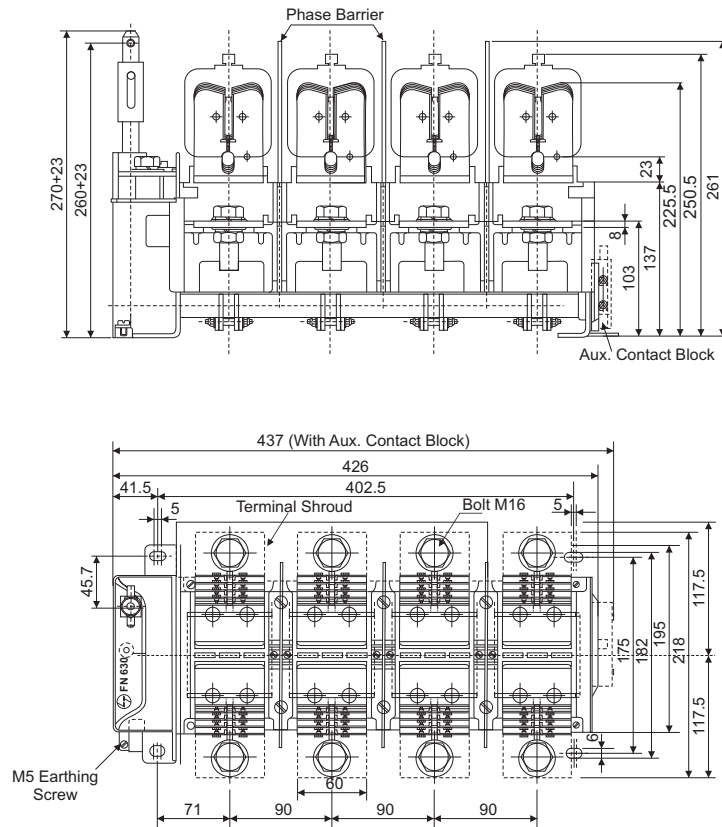


Technical drawing of a shaft-hub assembly. The shaft is a solid circle with a diameter of $\varnothing 60 \pm 0.25$. The hub is a rectangular block with a width of 60 ± 0.25 and a height of 60 ± 0.25 . The hub has four holes, each with a diameter of $\varnothing 4 \pm 0.1$, arranged in a 2x2 grid. The distance between the centers of the holes is 24.5 (horizontal) and 45.7 (vertical). The total width of the hub is labeled A . The shaft is shown with a diameter of $\varnothing 60 \pm 0.25$ and a length of 175 . The shaft is labeled "Operating Shaft Centre Mismatch ± 3 Permissible". The hub is labeled "4 Holes Suitable for M8 Screw".

Dimensions	For 2P & 3P Switches	For 4P Switches
A	215	285

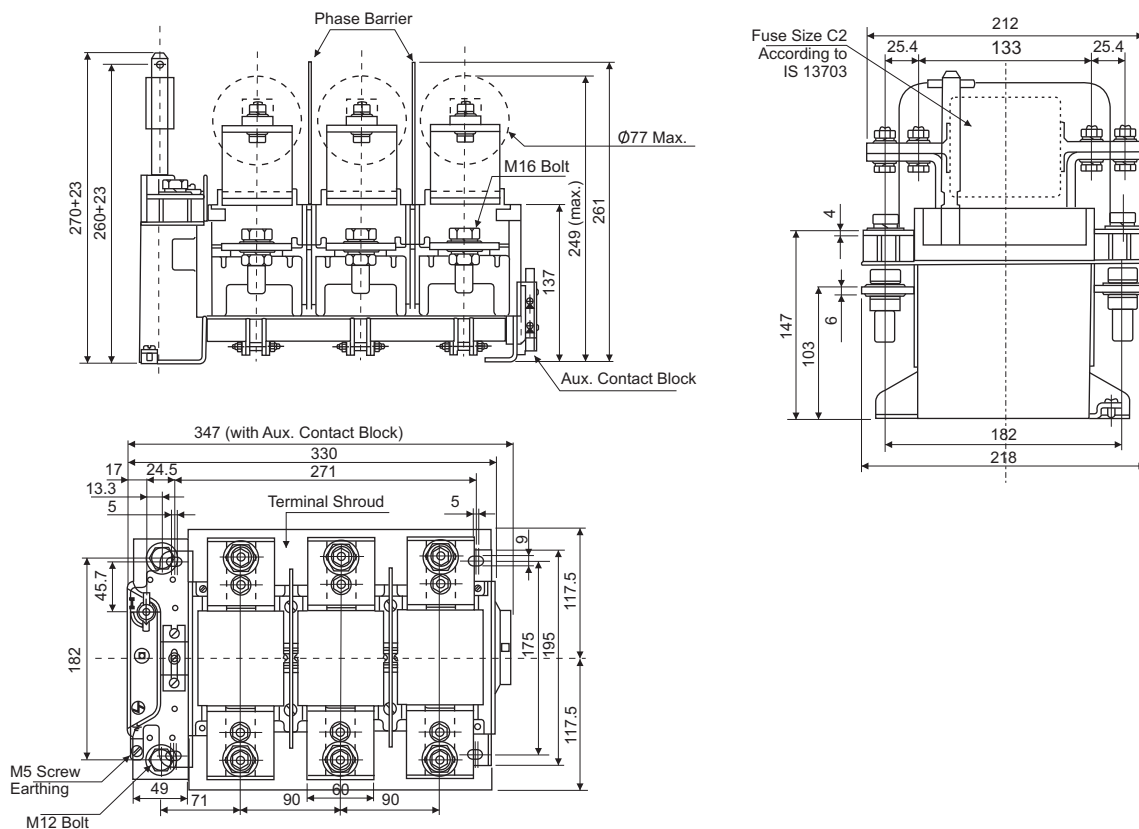


SDF - FN 630 4P

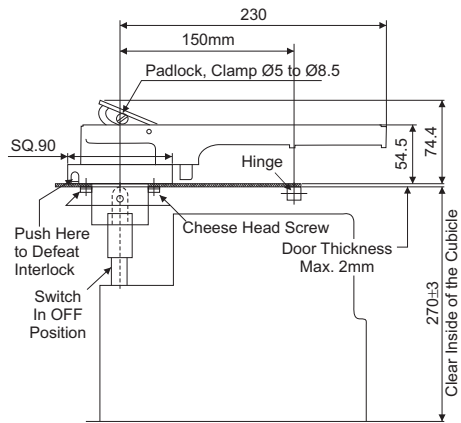


Switch-Disconnecter-Fuse (suitable for BOLTED type fuses)

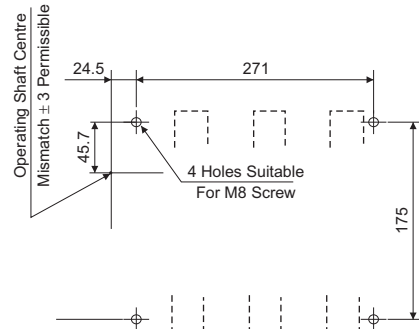
SDF - FN 630 TPN



Assembly of Handle Coupling on Door

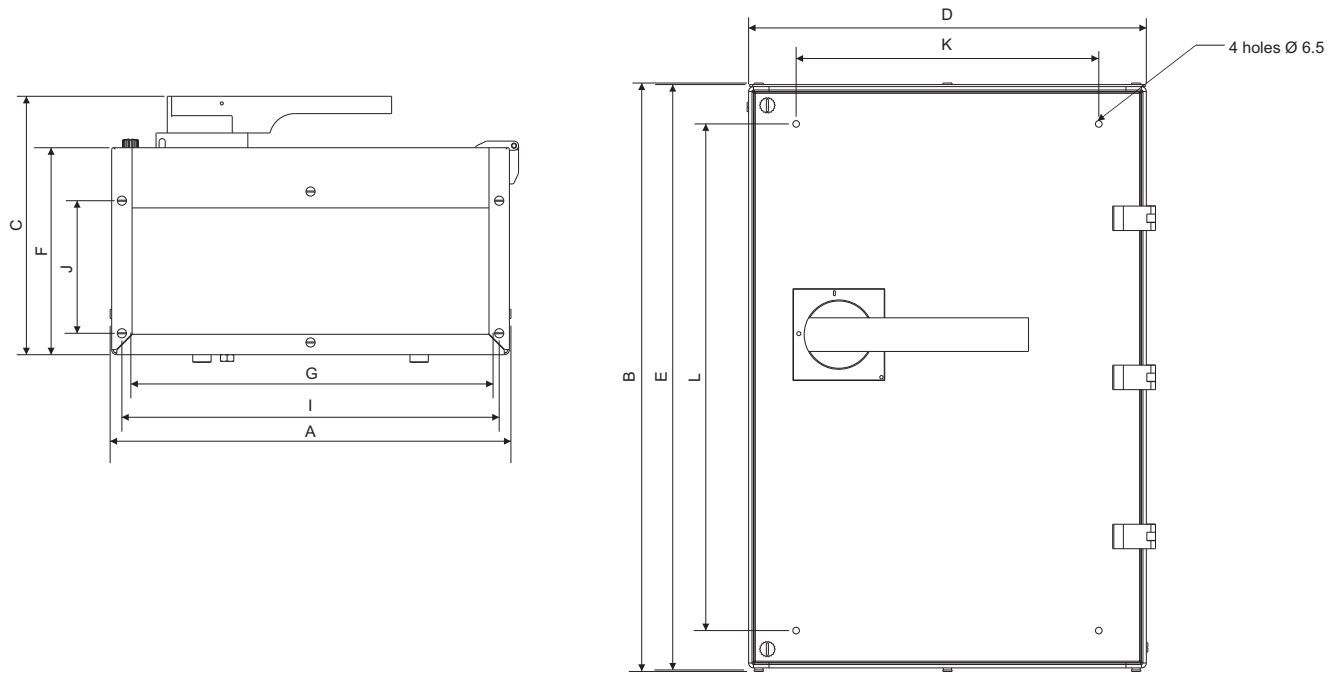


Drilling Details on Base Plate for Mounting Switch Seen From Front of the Door



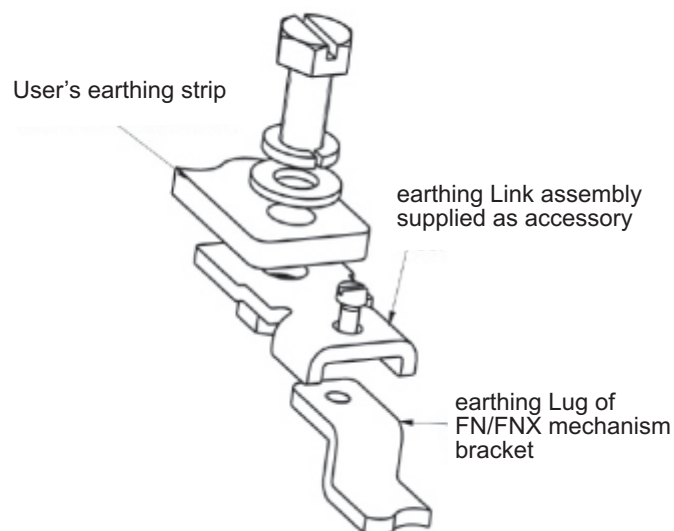
Switch Type	A
2P & 3P	271
4P	361

FN in Sheet Steel Enclosure



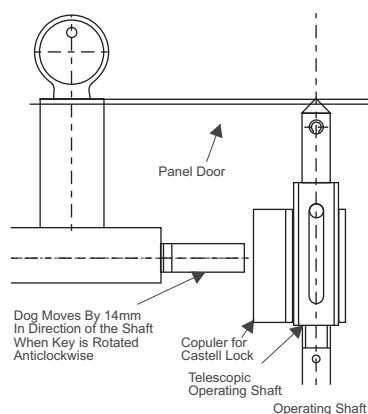
Type	Extreme overall dimension			Basic enclosure dimension			Cutout for Cables		GI and Plate mounting dimension		Enclosure mounting dimension	
	A	B	C	D	E	F	G	H	I	J	K	L
FN 32 / 63	277	325	196	262	310	153	222	108	242	113	160	230
FN 100 / 125 / 160	330	448	245	315	433	183	275	108	295	113	213	350
FN 200 / 250	405	585	265	390	570	203	350	130	370	130	213	350
FN 315 / 400	480	747	315	465	732	253	425	171	445	180	346	600
FN 630 / 800	480	747	337	465	732	273	425	171	445	180	346	600

Earthing Link Assembly

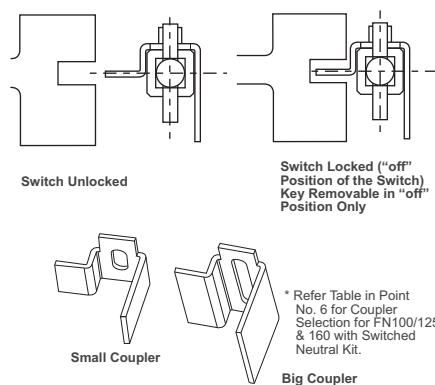


Assembly of Castell Lock with Telescopic Shaft

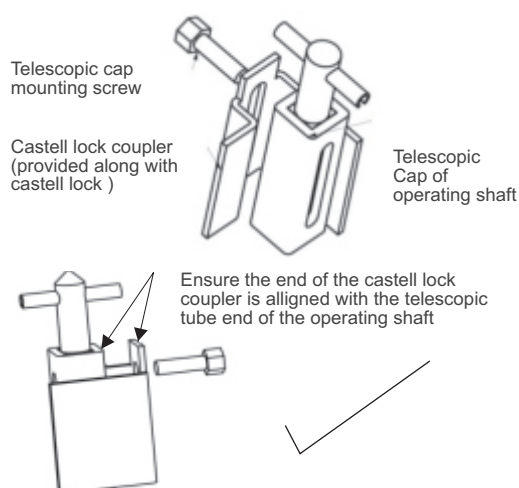
Arrangement of Castell Lock Inside the Panel



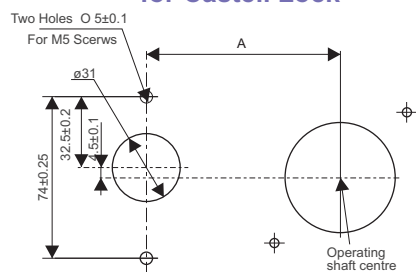
Castell Lock Positions with Telescopic Shaft



Mounting of Castell Lock Coupler

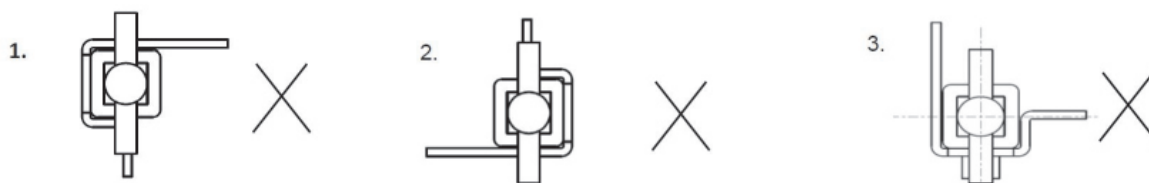


Drilling Details on Door for Castell Lock



Suitable for	Cat no.	Dim. A
160/200/250 FN 100/125	SK00333	88±0.25
	SK00334	
	SK00335	
	SK00336	
FN 315/400/ 630/800	SK00345	95.5±0.25
	SK00346	
	SK00347	
	SK00348	

Wrong method of assembly (as seen from front side in mounted condition)



Coupler selection guide for FN 100/125/160**

Product	Castell Lock No.	Switched Neutral Kit used	Shaft telescopicity used	Castell lock Coupler to be used
FN 100/125/160	SK00333	Yes	No	Small
	SK00334		Yes	Big
			No	Small
			Yes	Big
			No	Small
			Yes	Big
	SK00335	No	Small	
	SK00336	Yes	Big	
		SK00333	No	Big
	Yes			
	No			
	Yes			
No				
Yes				
SK00334	NO	No	Big	
SK00335		Yes		
		No		
		Yes		
		No		
		Yes		
SK00336	Yes			

** Small coupler not required for FN200/250

Note : All dimensions are in mm.

Notes:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Notes:

[illegible]

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