General information about motor protection

Typical construction of a motor starter

Disconnect Switch
UL 98 - UL489
CSA – C22.2 # 4
CSA – C22.2 # 5

SIRCO
Non-Fusible
Disconnect Switch
range

FUSERBLOC
Fusible Disconnect Switch
range

Fuses

Contactor

Overload relay

UL 508 Manual Motor Controller
"Suitable as Motor Disconnect"
CSA – C22.2 # 14

LBS Non-Fusible
Disconnect Switch range

Motor

Essential parts of a motor branch circuit required by the national electrical code

- Disconnect means
- Branch-circuit short-circuit protective device
- Motor-controller
- Motor overload protective devices

Disconnect means

The Disconnect means can be a Manual Disconnect Switch according to UL 98.

A manual Motor Controller (according to UL 508) additionally marked "Suitable as Motor Disconnect" is only permitted as a disconnecting means where installed between the final branch-circuit short-circuit and ground-fault protective device and the motor (NEC 2005 Article 430.109).

Branch-circuit short-circuit protective device

The short-circuit protective device can be either a Fuse or an Inverse-time Circuit-breaker.

Motor-controller

Any switch or device that is normally used to start and stop a motor according to the National Electrical Code article 430.81.

Motor overload protective devices

The National Electrical Code permits fuses to be used as the sole means of overload protection for motor branch circuits. This approach is often practical only with small single phase motors.

Most integral horsepower 3 phase motors are controlled by a motor starter which includes an overload relay. Since the overload relay provides overload protection for the motor branch circuit, the fuses may be sized for short-circuit protection.

Product features of non-fusible & fusible disconnect switches

Door interlock in ON position

The handles allow opening the door in the OFF position only.

In the ON position the door can not be opened.

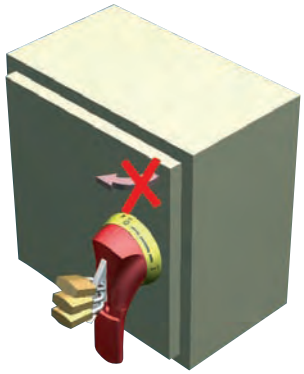
This interlocking can be by-passed by authorized personnel (defeater option on handle) for maintenance, testing or commissioning.

Defeater

The defeat function allows qualified personnel to by-pass the door interlock when the switch is in the ON position by means of a tool.

This exclusive design is also available in a NEMA 4 and 4X rating.

Padlocking



Handles can be padlocked in the OFF position with up to 3 padlocks. Meets OSHA requirement for lockout / tagout.

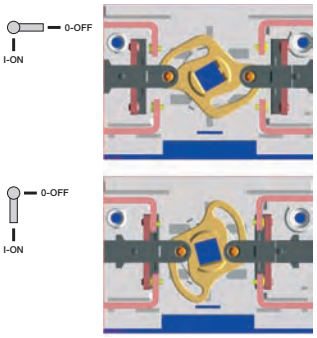
For safety reasons, the door can not be opened when the handle is padlocked.

Touch safe

Our design reduces or eliminates the danger of accidental contact with live, energized parts.

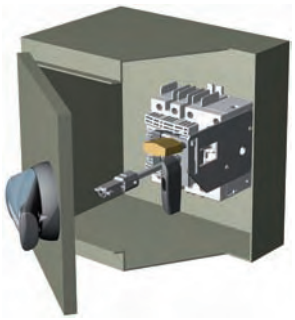
All products are supplied standard with line side shrouding.

Positive opening operation



The positive opening operation feature of our switches means that all the main contacts are ensured to be in the open position when the handle is in the "OFF" position.

New NFPA 79 requirements and solutions



As defined in the NFPA 79 Standard section 5.3.3.1 and 6.2.3.2, our disconnecting devices fully comply with all of the following requirements:

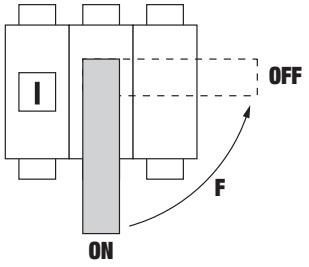
1. Isolate the electrical equipment from the supply circuit and have one off (open) and one on (closed) position only.
2. Have an external operating means (e.g., handle).
3. Be provided with a permanent means permitting it to be locked in the off (open) position only (e.g., by padlocks) independent of the door position. When so locked, remote as well as local closing shall be prevented.
4. Be operable, by qualified persons, independent of the door position without the use of accessory tools or devices.

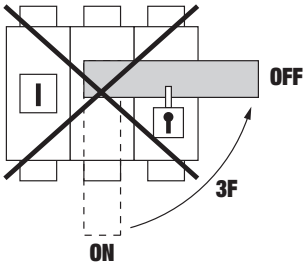
However the closing of the disconnecting means while door is open is not permitted unless an interlock is operated by deliberate action.

Flange and side operation:
Our side operated switches used with flange handles meet the requirements of the NFPA 79 without any additional parts being added.

Product features of non-fusible & fusible disconnect switches

Welded contact protection

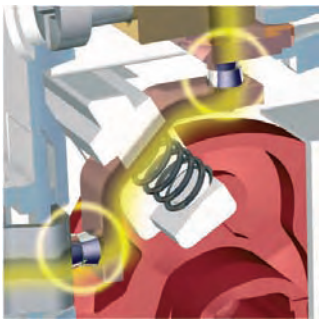




Positive opening operation safeguards users in case of welded contacts due to an overload or short-circuit. The handle can not reach the "OFF" position unless the contacts are truly open.

According to the IEC 947-3 standard if the contacts are welded due to an overload or short-circuit, the switch will not reach the "OFF" position and can not be padlocked in this position as long as operating force applied to the operating mechanism is less than a force three times the standard operating force. Thus, this unusual operation alerts the user that a problem has occurred.

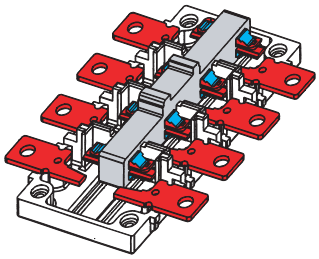
Contact principle



Up to 400 A

All switches use silver tipped contacts technology providing the following advantages:

- best solution for harsh environments (humidity, sulphide, chloride…),
- high on-load break characteristics,
- longer mechanical and electrical life,
- maintenance free switches without grease.



Above 400 A

Our switches use a self-cleaning moving contact technology allowing high short-circuit withstand.

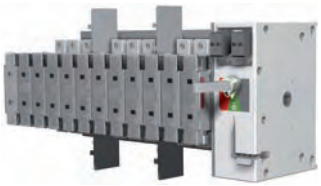
Clear position indicator

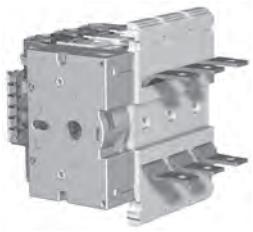
All switches and handles have clear "ON" and "OFF" designations.

Fast make and break contacts

All the Non-Fusible and Fusible Disconnect switches' contacts work independently of the speed and force of the operator providing better electrical characteristics (making capacities on short-circuits, highly inductive load operation possibilities).

Tailor-made solutions



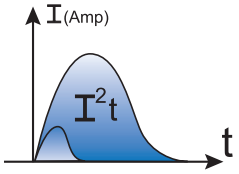


- Multipolar switches (examples: 12-pole 160 A switch; 18-pole 30 A switch…).
- Rear connections (top or/and bottom).
- Mixed pole (example: 3-pole 200 A + 2-pole 30 A switch…).

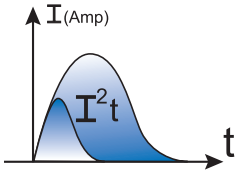
Please consult us.

Product features of fusible disconnect switches

Exceptional 200 kA short-circuit protection with



Fuse



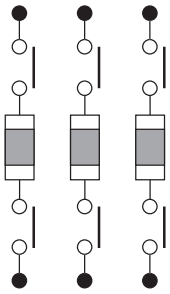
Circuit breaker

The Fuserbloc Series with class CC, J or L fuses provides exceptional high level of short-circuit protection, up to 200 kA.

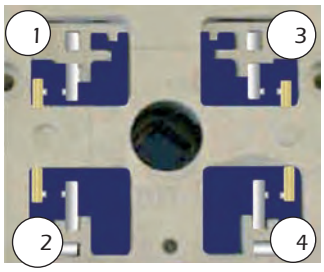
The CC and J fuses are more current limiting than older classes of fuses or circuit breakers. In other words, fuses have higher breaking capacities than most of the circuit breakers. Moreover discrimination (selectivity) and coordination are easily achieved with fuses.

The fuse solution brings the following advantages: high performance, reliability, safety, savings and ease of use.

Practical safeguard



Arc broken into 4

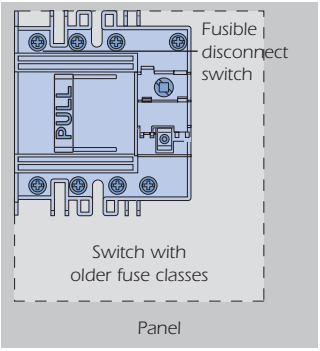


Double break

The modern designed mechanism of our Fusible Disconnect Switches disconnects both sides of the fuses using two double breaking contacts per pole. This ensures the complete isolation of the fuses in the "OFF" position and allows the switch to be fed from either top or bottom side.

This feature allows the switch to operate on highly inductive loads.

Panel space saving



Panel

This proven switch technology has the fuses incorporated on the top of the switch mechanism to reduce the footprint of the product and save you valuable real estate in your panel.

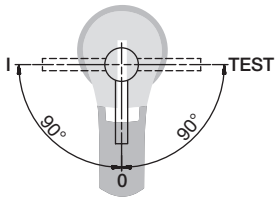
The space saving can be as much as 50% from the switches designed with use of older fuse classes.

Touch safe

Our design reduces or eliminates the danger of accidental contact with live, energized parts.

All switches are supplied standard with fuse cover and line side shrouding.

Fast and safe commisioning



The TEST feature enables the testing of the control circuit auxiliaries without switching the main contacts or removing the fuses.

This function provides a serious technical and commercial alternative to a separately wired push button.

Fusible disconnect switches' association chart with UL fuses

208 V according to typical motor acceleration times

Three phase motor fuse and fusible disconnect switch selection UL class CC

Motor HP	Full load amperes	Recommended fuse ampere rating for typical* 5 secs motor acceleration times	Recommended fuse	Recommended fusible disconnect switch	
208 V		Ampere rating (A)	Catalog number	Ampere rating (A)	Catalog number
1/2	2.4	8	ATDR8	30	FBCC30CDT FBCC30 - FBCC304 FBCC30SO - FBCC304SO
3/4	3.5	10	ATDR10		
1	4.6	15	ATDR15		
1-1/2	6.6	20	ATDR20		
2	7.5	20	ATDR20		
3	10.6	30	ATDR30		

Three phase motor fuse and fusible disconnect switch selection UL class J

Motor HP	Full load amperes	Recommended fuse ampere rating for typical* 5 secs motor acceleration times	Recommended fuse	Recommended fusible disconnect switch	
208 V		Ampere rating (A)	Catalog number	Ampere rating (A)	Catalog number
1/2	2.4	3-1/2	AJT3-1/2	30	FBJ30CDT FBJ30 - FBJ304 FBJ30SO - FBJ304SO
3/4	3.5	5	AJT5		
1	4.6	7	AJT7		
1-1/2	6.6	10	AJT10		
2	7.5	10	AJT10		
3	10.6	15	AJT15		
5	16.8	25	AJT25		
7-1/2	24.2	35	AJT35	60	FBJ60 - FBJ604 FBJ60SO - FBJ604SO
10	30.8	45	AJT45		
15	46.2	70	AJT70	100	FBJ100 - FBJ1004 FBJ100SO - FBJ1004SO
20	60	90	AJT90		
25	75	110	AJT110	200	FBJ200 - FBJ2004 FBJ200SO - FBJ2004SO
30	88	150	AJT150		
40	114	175	AJT175		
50	143	225	AJT225	400	FBJ400 - FBJ4004 FBJ400SO - FBJ4004SO
60	169	250	AJT250		
75	211	350	AJT350		
100	273	400	AJT400		
125	343	500	AJT500	600	FBJ600 - FBJ6004
150	396	600	AJT600		

* Typical: suggested for most applications. Will coordinate with NEMA Class 20 overload relays. Suitable for motor acceleration times up to 5 seconds.

Fusible disconnect switches' association chart with UL fuses

230 V according to typical motor acceleration times

Three phase motor fuse and fusible disconnect switch selection UL class CC

Motor HP	Full load amperes	Recommended fuse ampere rating for typical* 5 secs motor acceleration times	Recommended fuse	Recommended fusible disconnect switch	
230 V		Ampere rating (A)	Catalog number	Ampere rating (A)	Catalog number
1/2	2.2	7	ATDR7	30	FBCC30CDT FBCC30 - FBCC304 FBCC30SO - FBCC304SO
3/4	3.2	10	ATDR10		
1	4.2	12	ATDR12		
1-1/2	6	17-1/2	ATDR17-1/2		
2	6.8	20	ATDR20		
3	9.6	30	ATDR30		

Three phase motor fuse and fusible disconnect switch selection UL class J

Motor HP	Full load amperes	Recommended fuse ampere rating for typical* 5 secs motor acceleration times	Recommended fuse	Recommended fusible disconnect switch	
230 V		Ampere rating (A)	Catalog number	Ampere rating (A)	Catalog number
1/2	2.2	3-1/2	AJT3-1/2	30	FBJ30CDT FBJ30 - FBJ304 FBJ30SO - FBJ304SO
3/4	3.2	5	AJT5		
1	4.2	6-1/4	AJT6-1/4		
1-1/2	6	9	AJT9		
2	6.8	10	AJT10		
3	9.6	15	AJT15		
5	15.2	25	AJT25		
7-1/2	22	35	AJT35	60	FBJ60 - FBJ604 FBJ60SO - FBJ604SO
10	28	40	AJT40		
15	42	60	AJT60		
20	54	80	AJT80	100	FBJ100 - FBJ1004 FBJ100SO - FBJ1004SO
25	68	100	AJT100		
30	80	125	AJT125	200	FBJ200 - FBJ2004 FBJ200SO - FBJ2004SO
40	104	150	AJT150		
50	130	200	AJT200		
60	154	225	AJT225	400	FBJ400 - FBJ4004 FBJ400SO - FBJ4004SO
75	192	300	AJT300		
100	248	350	AJT350		
125	312	450	AJT450	600	FBJ600 - FBJ6004
150	360	500	AJT500		

* Typical: suggested for most applications. Will coordinate with NEMA Class 20 overload relays. Suitable for motor acceleration times up to 5 seconds.

Fusible disconnect switches' association chart with UL fuses

460 V according to typical motor acceleration times

Three phase motor fuse and fusible disconnect switch selection UL class CC

Motor HP	Full load amperes	Recommended fuse ampere rating for typical* 5 secs motor acceleration times	Recommended fuse	Recommended fusible disconnect switch	
460 V		Ampere rating (A)	Catalog number	Ampere rating (A)	Catalog number
1/2	1.1	3-1/2	ATDR3-1/2	30	FBCC30CDT FBCC30 - FBCC304 FBCC30SO - FBCC304SO
3/4	1.6	5	ATDR5		
1	2.1	6-1/4	ATDR6-1/4		
1-1/2	3	9	ATDR9		
2	3.4	10	ATDR10		
3	4.8	15	ATDR15		
5	7.6	25	ATDR25		
7-1/2	11	30	ATDR30		

Three phase motor fuse and fusible disconnect switch selection UL class J

Motor HP	Full load amperes	Recommended fuse ampere rating for typical* 5 secs motor acceleration times	Recommended fuse	Recommended fusible disconnect switch	
460 V		Ampere rating (A)	Catalog number	Ampere rating (A)	Catalog number
1/2	1.1	1-6/10	AJT1-6/10	30	FBJ30CDT FBJ30 - FBJ304 FBJ30SO - FBJ304SO
3/4	1.6	2-1/4	AJT2-1/4		
1	2.1	3-2/10	AJT3-2/10		
1-1/2	3	4-1/2	AJT4-1/2		
2	3.4	5	AJT5		
3	4.8	8	AJT8		
5	7.6	12	AJT12		
7-1/2	11	17-1/2	AJT17-1/2		
10	14	20	AJT20		
15	21	30	AJT30		
20	27	40	AJT40	60	FBJ60 - FBJ604 FBJ60SO - FBJ604SO
25	34	50	AJT50		
30	40	60	AJT60		
40	52	80	AJT80	100	FBJ100 - FBJ1004 FBJ100SO - FBJ1004SO
50	65	100	AJT100		
60	77	125	AJT125	200	FBJ200 - FBJ2004 FBJ200SO - FBJ2004SO
75	96	150	AJT150		
100	124	200	AJT200		
125	156	225	AJT225	400	FBJ400 - FBJ4004 FBJ400SO - FBJ4004SO
150	180	250	AJT250		
200	240	350	AJT350		
250	302	450	AJT450	600	FBJ600 - FBJ6004
300	361	600	AJT600		

* Typical: suggested for most applications. Will coordinate with NEMA Class 20 overload relays. Suitable for motor acceleration times up to 5 seconds.

Fusible disconnect switches' association chart with UL fuses

575 V according to typical motor acceleration times

Three phase motor fuse and fusible disconnect switch selection UL class CC

Motor HP	Full load amperes	Recommended fuse ampere rating for typical* 5 secs motor acceleration times	Recommended fuse	Recommended fusible disconnect switch	
575 V		Ampere rating (A)	Catalog number	Ampere rating (A)	Catalog number
1/2	0.9	2-8/10	ATDR2-8/10	30	FBCC30CDT FBCC30 - FBCC304 FBCC30SO - FBCC304SO
3/4	1.3	4	ATDR4		
1	1.7	5-6/10	ATDR5-6/10		
1-1/2	2.4	8	ATDR8		
2	2.7	8	ATDR8		
3	3.9	12	ATDR12		
5	6.1	17-1/2	ATDR17-1/2		
7-1/2	9	30	ATDR30		
10	11	30	ATDR30		

Three phase motor fuse and fusible disconnect switch selection UL class J

Motor HP	Full load amperes	Recommended fuse ampere rating for typical* 5 secs motor acceleration times	Recommended fuse	Recommended fusible disconnect switch	
575 V		Ampere rating (A)	Catalog number	Ampere rating (A)	Catalog number
1/2	0.9	1-1/2	AJT1-1/2	30	FBJ30CDT FBJ30 - FBJ304 FBJ30SO - FBJ304SO
3/4	1.3	2	AJT2		
1	1.7	2-1/2	AJT2-1/2		
1-1/2	2.4	3-1/2	AJT3-1/2		
2	2.7	4	AJT4		
3	3.9	6	AJT6		
5	6.1	10	AJT10		
7-1/2	9	15	AJT15		
10	11	17-1/2	AJT17-1/2		
15	17	25	AJT25		
20	22	35	AJT35	60	FBJ60 - FBJ604 FBJ60SO - FBJ604SO
25	27	40	AJT40		
30	32	50	AJT50		
40	41	60	AJT60		
50	52	80	AJT80	100	FBJ100 - FBJ1004 FBJ100SO - FBJ1004SO
60	62	90	AJT90		
75	77	125	AJT125	200	FBJ200 - FBJ2004 FBJ200SO - FBJ2004SO
100	99	150	AJT150		
125	125	200	AJT200		
150	144	225	AJT225	400	FBJ400 - FBJ4004 FBJ400SO - FBJ4004SO
200	192	300	AJT300		
250	240	350	AJT350		
300	289	450	AJT450	600	FBJ600 - FBJ6004

* Typical: suggested for most applications. Will coordinate with NEMA Class 20 overload relays. Suitable for motor acceleration times up to 5 seconds.

Fusible disconnect switches' association chart with HSJ fuses

HSJ and FBJ coordination

Maximum current can be below fuse rating due to HSJ high watt loss

Rating of the HSJ fuse (A)	Watt loss at In	Type of fusible disconnect switches	Current max (A)	Type of fusible disconnect switches	Current max (A)
15	2.6	30 J CD	15	30 J	15
17.5	3.5	30 J CD	17	30 J	17.5
20	3.7	30 J CD	18	30 J	20
25	4	30 J CD	21	30 J	24
30	4.1	30 J CD	24	30 J	24
35	5.3	60 J	35	-	-
40	5.5	60 J	40	-	-
45	6	60 J	45	-	-
50	6.8	60 J	48	-	-
60	8.4	60 J	48	-	-
70	10	100 J	70	-	-
80	11	100 J	80	-	-
90	13	100 J	80	-	-
100	14	100 J	80	-	-
110	18	200 J	110	-	-
125	19	200 J	125	-	-
150	22	200 J	150	-	-
175	24	200 J	160	-	-
200	26	200 J	160	-	-
225	30	400 J	225	-	-
250	36	400 J	229	-	-
300	38	400 J	250	-	-
350	40	400 J	270	-	-
400	42	400 J	280	-	-

Correction factors for non-fusible & fusible disconnect switches

Correction factors due to ambient air temperature

Method: Ithu ≤ Ith x Kt

ta: ambient temperature
Ith: thermal switch current
Kt: correction factor due to ambient temperature ta
Ithu: maximum thermal current after correction

Non-Fusible Disconnect Switches

	T (° C)		
Ith	40°C < ta ≤ 50°C	50°C < ta ≤ 60°C	60°C < ta ≤ 70°C
V30 A	1	0.8	0.7
V60 A	1	1	1
V100 A	1	1	1
V200 A	1	1	0.9
V400 A	1	0.9	0.8
400 A	1	1	1
600 A	1	1	0.9
800 A	1	1	1
1000 A	1	1	0.9
1200 A	1	0.9	0.8

Fusible Disconnect Switches

	T (° C)		
Ith	40°C < ta ≤ 50°C	50°C < ta ≤ 60°C	60°C < ta ≤ 70°C
30 A CC CD type	0.9	0.8	0.7
30 A J CD type	0.9	0.8	0.7
30 A CC	1	1	1
30 A J	1	1	1
60 A J	1	1	1
100 A J	1	1	1
200 A J	1	1	1
400 A J	0.9	0.8	0.7
600 A J	1	1	1
800 A L	1	1	1

Correction factors due to frequency

Method: Ithu ≤ Ith x Kf

f: rated operating frequency
Ith: thermal switch current
Kf: correction factor due to operating frequency F
Ithu: maximum thermal current after correction

Non-Fusible Disconnect Switches

	f (Hz)		
Ith	100 Hz < f ≤ 2000 Hz	2000 Hz < f ≤ 6000 Hz	6000 Hz < f ≤ 10000 Hz
V30 A	1	0.7	0.6
V60 A	1	1	1
V100 A	1	1	1
V200 A	1	1	1
V400 A	0.9	0.8	0.7
400 A	1	1	1
600 A	1	0.9	0.8
800 A	1	1	0.9
1000 A	1	0.9	0.8
1200 A	1	0.7	0.6

Fusible Disconnect Switches

	f (Hz)		
Ith	100 Hz < f ≤ 2000 Hz	2000 Hz < f ≤ 6000 Hz	6000 Hz < f ≤ 10000 Hz
30 A CC CD type	0.8	0.7	0.6
30 A J CD type	0.8	0.7	0.6
30 A CC	1	1	1
30 A J	1	1	1
60 A J	1	1	1
100 A J	1	1	1
200 A J	1	0.9	0.8
400 A J	0.8	0.7	0.6
600 A J	1	1	1
800 A L	1	1	1

NEMA ratings and IP cross-reference

This table provides a guide for converting from NEMA Enclosure Type Numbers to IP Ratings. The NEMA Types meet or exceed the test requirements for the associated European Classifications; for this reason the table should not be used to convert "from IP Rating to NEMA" and the "NEMA to IP Rating" should be verified by test.

NEMA type	Intended use and description	NEMA ratings and IP cross-reference
1	Indoor use primarily to provide a degree of protection against contact with the enclosed equipment and against a limited amount of falling dirt.	NEMA 1 meets or exceeds IP10
2	Indoor use to provide a degree of protection against a limited amount of falling water and dirt.	NEMA 2 meets or exceeds IP11
3	Intended for outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust, and damage from external ice formation.	NEMA 3 meets or exceeds IP54
3R	Intended for outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation.	NEMA 3R meets or exceeds IP14
3S	Intended for outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust, and to provide for operation of external mechanisms when ice laden.	NEMA 3S meets or exceeds IP54
4	Intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, hose-directed water, and damage from external ice formation.	NEMA 4 meets or exceeds IP56
4X	Intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water, and damage from ice formation.	NEMA 4X meets or exceeds IP56
6	Intended for indoor or outdoor use primarily to provide a degree of protection against hose-directed water, the entry of water during occasional temporary submersion at a limited depth, and damage from external ice formation.	NEMA 6 meets or exceeds IP67
6P	Intended for indoor or outdoor use primarily to provide a degree of protection against hose-directed water, the entry of water during prolonged submersion at a limited depth, and damage from external ice formation.	NEMA 6P meets or exceeds IP67
12	Intended for indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping non-corrosive liquids.	NEMA 12 meets or exceeds IP52
12K	Type 12 with knockouts.	NEMA 12K meets or exceeds IP52

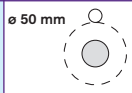
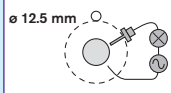
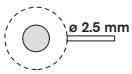
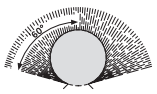
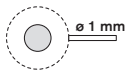
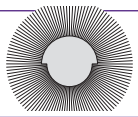
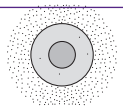
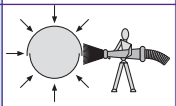
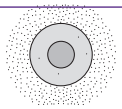
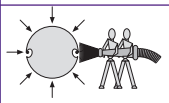
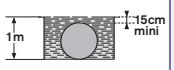
Wire size cross reference

AWG	mm^2
14	2.1
12	3.3
10	5.3
8	8.4
6	13.3
4	21.2
3	26.7
2	33.6
1	42.4
1/0	53.5
2/0	67.4
3/0	85.0
4/0	107.2

kcmil/mcm	mm^2
250	127
300	152
350	177
400	203
500	253
600	304
700	355
750	380
800	405
900	456
1000	507
1250	633
1500	760
1750	887
2000	1014

Degrees of protection (IP codes according to IEC 60529 standard)

The degrees of protection are defined by two numbers and sometimes by an additional letter.
For example: IP 55 or IP xx B (x indicates: any value).
The numbers and additional letters are defined below:

First number protection against solid body penetration			Second number protection against liquid penetration			Additional letter[2]	Degree of protection
IP	**Tests**		**IP**	**Tests**			**Brief description**
0		No protection	0		No protection		
1		Protected against solid bodies greater than 50 mm	1		Protected against water drops falling vertically (condensation)	A	Protected against access with back of hand
2[1]		Protected against solid bodies greater than 12 mm	2		Protected against water drops falling up to 15° from the vertical	B	Protected against access with finger
3		Protected against solid bodies greater than 2.5 mm	3		Protected against water showers up to 60° from the vertical	C	Protected against access with tool
4		Protected against solid bodies greater than 1 mm	4		Protected against water splashes from any direction	D	Protected against access with wire
5		Protected against dust (excluding damaging deposits)	5		Protected against water jets from any hosed direction		
6		Total protection against dust	6		Protected against water splashes comparable to heavy seas		
The first two numbers are defined by NF EN 60 529, IEC 529 and DIN 40 050			7		Protected against total immersion		

Note:

(1) Fig. 2 is established by 2 tests:
- non penetration of a sphere with the diameter of 12.5 mm
- non accessibility of a test probe with a diameter of 12 mm.

(2) This additional letter only defines the access to dangerous components
Example: A device has an aperture allowing access with a finger. This will not be classified as IP 2x. However, if the components which are accessible with a finger are not dangerous (electric shock, burns, etc.), the device will be classified as xx B.

IEC 947-1 & IEC 947-3 standards

Selecting switches according to IEC 947 -3 standard

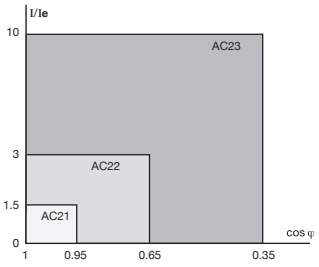
Utilization category		Use	Application
AC	DC		
AC20	DC20	No-load making and breaking	Disconnector (device without on-load making and breaking capacity
AC21	DC21	Resistive including moderate overloads	Switches at installation head or for resistive circuits (heating, lighting, except discharge lamps, etc.)
AC22	DC22	Inductive and resistive mixed loads including moderate overloads	Switches in secondary circuits or reactive circuits (capacitor banks, discharge lamps, shunt motors, etc.)
AC23	DC23	Loads made of motor or other highly inductive loads	Switches feeding one or several motors or inductive circuits (electric carriers, brake magnet, series motor, etc.)

Breaking and making capacities

Unlike circuit breakers, where these criteria indicate tripping or short-circuit making characteristics and perhaps requiring device replacement, switch making and breaking capacities correspond to utilization category maximum performance values.

In these uses, the switch must still maintain its characteristics, in particular its resistance to leakage current and temperature rise.

	Making		Breaking		N° of operating cycles
	I/Ie	cos φ	I/Ie	cos φ	
AC 21	1.5	0.95	1.5	0.95	5
AC 22	3	0.65	3	0.65	5
AC 23 I ≤ 100 A	10	0.45	8	0.45	5
AC 23 Ie > 100 A	10	0.35	8	0.35	3
	L/R (ms)		L/R (ms)		
DC 21	1.5	1	1.5	1	5
DC 22	4	2.5	4	2.5	5
DC 23	4	15	4	15	5



Making and breaking capacities.

Short circuit characteristics

- Short-time withstand current (Icw): allowable rms current for 1 second.
- Short circuit making capacity (Icm): peak current value which the device can withstand when closed on a short-circuit.
- Conditional short circuit current: the rms current the switch can withstand when associated with a protection device limiting both the current and short circuit duration.
- Dynamic withstand: peak current the device can withstand in a closed position.

The characteristic established by this standard is the short-time withstand current (Icw) from which minimal dynamic withstand is deduced. This essential withstand value corresponds to what the switch can stand without welding.

Electrical and mechanical endurance

This standard establishes the minimum number of electrical (full load) and mechanical (no-load) operating cycles that must be performed by devices. These characteristics also specify the device's theoretical lifespan during which it must maintain its characteristics, particularly resistance to leakage current and temperature rise.

This performance is linked to the device's use and rating. According to anticipated use, two additional application categories are offered:

- category A: frequent operations (in close proximity to the load),
- category B: infrequent operations (at installation head or wiring system).

Ie (A)	≤ 100	≤ 315	≤ 630	≤ 2500	> 2500
N° cycles/hour	120	120	60	20	10
N° of operations in cat. A					
without current	8500	7000	4000	2500	1500
with current	1500	1000	1000	500	500
Total	10000	8000	5000	3000	2000
N° of operations in cat. B					
without current	1700	1400	800	500	300
with current	300	200	200	100	100
Total	2000	1600	1000	600	400

Definitions

Conventional thermal current (Ith): Value of the current the disconnect switch can withstand with pole in closed position, in free air for an eight hour duty, without the temperature rise of its various parts exceeding the limits specified by the standards.

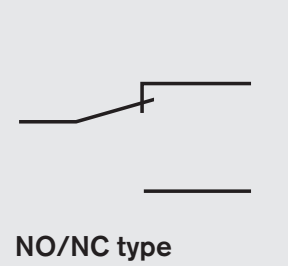
Rated insulation voltage (Ui): Voltage value which designates the unit and to which dielectric tests, clearance and creepage distances are referred.

Rated impulse withstand voltage (Uimp): Peak value of an impulse voltage of prescribed form and polarity which the equipment is capable of withstanding without failure under specified conditions of test and to which the values of the clearances are referred.

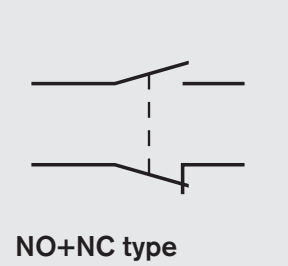
Rated operating current (Ie): Current value determined by endurance tests (both mechanical and electrical) and by making and breaking capacity tests.

Auxiliary contacts

Auxiliary contact wiring diagrams



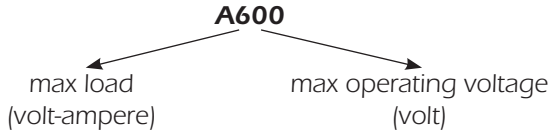
NO/NC type



NO+NC type

Auxiliary contact rating codes (according to UL508 standard item 139)

Designation



These codes concern the auxiliary contacts and give the maximum load they can make or break. The numerical suffix designates the maximum voltage design values, which are to be 600, 300 and 150 volts for suffixes 600, 300 and 150 respectively. The table below gives some typical rating codes:

Example

A contactor used at 600 VAC - 60 Hz has the following specifications:

Average consumption: - inrush 60 Hz: 1200 VA
- sealed 60 Hz: 120 VA

Thus a C600 rated auxiliary device is the minimum rating required.

Contact rating code designation	Max operating voltage (V)	Network type	Making max load (VA)	Breaking max load (VA)
A600	600	AC	7200	720
B600	600	AC	3600	360
C600	600	AC	1800	180
D300	300	AC	432	72
E150	150	AC	216	36
N600	600	DC	275	275
P600	600	DC	138	138
Q600	600	DC	69	69
R300	300	DC	28	28

Note: A600 and N600 are the highest categories and may be used to cover all cases.