Information

The PROCON multipole heavy duty connector system

The rapid economic development in the fifties of the past century, especially in the construction of machines and industrial plants required a so far unknown flexibility. Permanent adaption to the latest developments in technology demanded modified or new devices. It soon became obvious that only automated plants could provide the necessary precision and quality. Automated processes within machines and plants required equipment which was able to permanently control the processes and update the measuring data. The wiring systems used previously were no longer able to meet these requirements.

This led to the development of rectangular heavy duty connectors. This type of construction offers the best possible use of space for different contact arrangements which determine the different series. In addition the rectangular form is ideal for an easy and space-saving assembly in machine recesses, in profile steels and switch cabinets.

To receive a complete connector the following components have to be ordered:

Female insert

with screw terminal, crimp-type terminal *(please order contacts separately)*, or insulation displacement technique.

Male insert

with screw terminal or crimp-type terminal *(please order contacts separately)* or insulation displacement technique.

Hood

Low or high version, top or side cable entry, double locking system.

Housing base

- Panel housings, with or without cover, plastic or metal, single or double locking system.
- Wall mount housings, low or high version, with or without cover, plastic or metal, single or double locking system, one or two cable entries.
- Coupler hoods, for flying connections

Accessories

Different cable glands, separately available protective caps, coding pins and sleeves as well as guiding pins and sleeves for coding.

Within the PROCON multipole heavy duty connector system one housing is not assigned to only one series. It can accomodate female or male inserts of different series. Housings for female or male contact carriers are used instead of plugs and sockets.
Therefore in a not completely enclosed environment the designer can place the partly live contacts into a female insert.

The PROCON series differ within their electric rated values. Ratings like rated current, rated voltage, rated surge, pollution degree, contact resistance and temperature range will be determined by the construction of the contact carriers. For details please refer to the specification sheets of the special series. However there are several features regarding the termination methods which apply to all series.

Regulations and approvals

PROCON multipole heavy duty connectors are designed in compliance with
DIN VDE 0627
DIN VDE 0110
IEC 60 664-1
DIN EN 61 984
DIN EN 60 529
DIN EN 175 301-801
DIN/IEC 512.

Most of the indicated PRO-CON multipole heavy duty connectors have the following approvals, some of them valid for several countries:

CE marking

According to the European Commission PROCON multipole heavy duty connectors as electroncic components do not have to be identified with the CE mark (Guidelines on the Application of Council Directive 73/23/ EEC - July 1997).

Advantages of PROCON multipole heavy duty connectors

- easy operation due to ingenious locking technique
- ergonomically designed handles
- large wiring space in different housing sizes
- inserts have contact numbers clearly marked
- open, captive screws for easy mounting of the contact inserts
- high-quality powder coating of the housings
- easy and space-saving assembly in machine recesses, profile steels and switch cabinets
- fixing dimensions indicated on the base of the housings
- plant components can be mounted independently at different locations and then be assembled on the spot. All electric connections then only have to be fit together.
- various coding possibilities available with PROCON multipole heavy duty connectors of matching series and number of poles thereby preventing possi-bility of wrong connections
- parts of a system can easily be removed for maintenance or testing at other locations and quickly be replaced as required
- with PROCON heavy duty connectors the putting into operation of systems on-site can be realized exactly on schedule.
- quality assurance according to DIN EN ISO 9001
- made in Germany

Application areas for PROCON multipole heavy duty connectors

e.g. construction of switch boards

PROCON multipole heavy duty connectors are used for control and measuring techniques as well as in the operation of machines and electrical plants. Serving both as current supply and for control functions they are ideal for light and stage applications.

PROCON multipole heavy duty connectors also serve as interfaces for PCs and diagnosis devices to transmit or control operating data.

Screw mountable hoods

This alternative saves the panel housing. Each of the two unexpensive panel flanges is screwed with the switch cabinet wall by means of two screws. Then the insert is mounted in the flanges. The mounted hood is then put on the flanges and fixed with 2 screws M 6. Protection degree IP 68. Available with top or side cable entry.

Adapters and cover plates

Standardisation in switch cabinet construction also brought about new developments in the heavy duty connectors sector. The advantage of the plug-in panel technique can only be guaranteed if the panel can be removed from the switch cabinet. Therefore it is necessary that all connections are easily disconnectable from the panel and that the designations of the panels are clearly defined (interfaces, e.g. V 24, RS 485). Therefore adapter plates for subminiature connectors are used which make it possible to mount the contact carriers into the PROCON housing. The disconnectable exits from the panel are made by panel housings. The switch cabinets have side walls with prestamped rectangular cut outs for the panel housing B 24. If panel housings of other series are required they can be adapted to the existing cut out with adapter plates. In addition cover plates can be used which enable a later upgrade of the switch cabinet.

Wiring adapters, combi snap element

Special contact carriers with wiring adapters are available for panel housings. They allow direct measurement during operation, are clear to mark and easily accessible. In combination with the combi snap element the wiring adapters are mountable on DIN rails and can therefore be used in switch cabinets where they do not need a degree of protection.

Snap-on mounting adapters

Snap-on mounting adapters replace terminal blocks at those locations where the exits lead to peripheral sub-assemblies or -components. Like terminal blocks they can be mounted on DIN rails. In particular the swing-type mounting plate for contact carriers offers many advantages as it allows easy access to the terminals and therefore measurement during operation. In addition the base of the snap-on mounting adapter offers enough space to accommodate assigned electronic units like optocouplers, protective diodes, filters and similar functions.

The biggest advantage is a disconnectible but nevertheless safe connection of male and female insert.

Housings

PROCON housings can be divided into:

installed housings

- wall mount housings with one or two cable entries
- panel housings with one bottom cable entry for installation in switch cabinets

independent housings

- hoods
- coupler hoods

The user can choose from a great variety of housing sizes. They offer enough wiring space for large conductor sizes and provide better dissipation of heat because of their larger surface.

Twice the size PROCON housings (series A 32, B 32 and B 48) for individual application enable the accommodation of two contact inserts/carriers - e.g. two inserts series BA 6 or one insert series DD 72 - together in one housing. This allows simultaneous transmission of for example 6 x 35 A power and 72 x signal or control impulses.

If several heavy duty connectors are mounted close to each other the operation of the locking levers may be difficult due to a lack of space. PROCON multipole heavy duty connectors also offer locking with bipartite locking levers, meaning that both levers can be operated separately. This provides. easier operation in areas of restricted access.

Locking systems

Locking systems

The housings within the different Procon series are also available with various locking systems. So the user can choose the suitable locking systems for his special requirements. The following types of locking systems are available:

- Double locking system
- Single locking system
- Central locking system
- Screw-mountable hoods
- Hoods with bayonet lock

The levers of double and single locking system can be attached at the housing bases. Housing bases with double locking system can only be covered with loose protective caps.

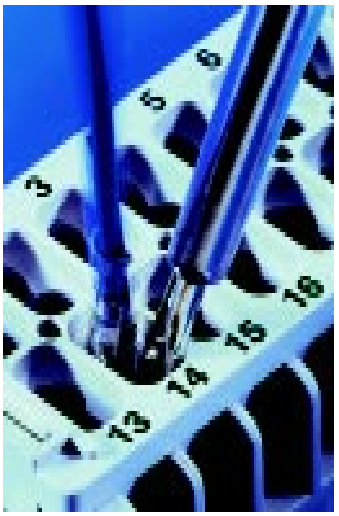
On housing bases with single locking system the protective cap *(plastic or aluminium)* can be fixed with hinges and it can be closed tightly with the single locking lever if the connection is separated.

On housings with central locking system the locking lever is mounted on the top part - this is very space-saving and ideal for side-by-side arrangements. No protective covers are available here.

The screw-mountable hoods are fixed with two M 6 screws. Protection degree IP 68. Unauthorized opening of the hoods is made more difficult since tools have to be used. Here protective covers are available for both switch cabinets and hoods.

Also double locking levers can be attached on the housing tops so that these can be snapped onto the housing bases.

Furthermore, protective covers can be fixed with hinges on the housing bases. The covers, however, are not lockable.

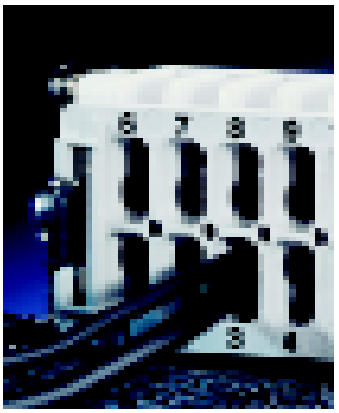


Screw terminal with wire protection

prevents the slipping out and cutting off of the wires in a flexible cable.

Screw terminal without wire protection

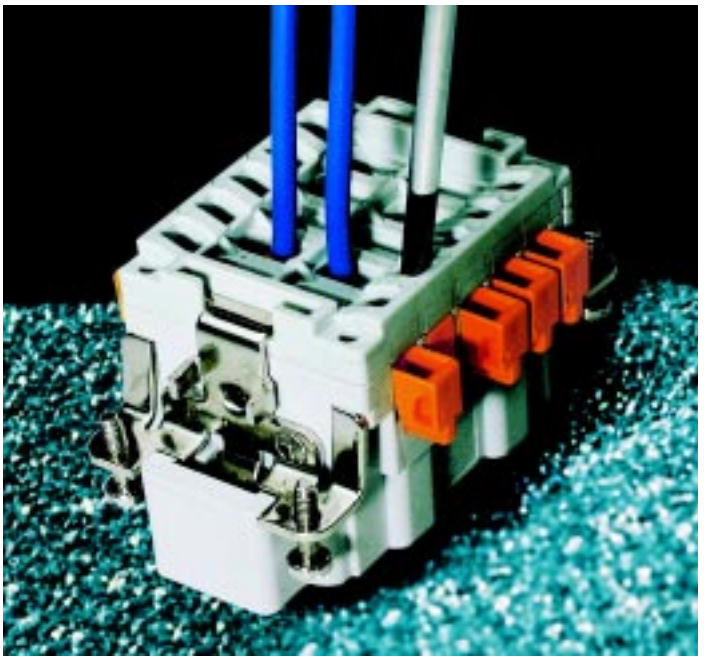
is used in installations with pre-wired cables with pin cable lugs or crimp type pin terminals. The screw terminal is quick and easy to operate and therefore the most widely used. The quality of the connection however depends very much on the thoroughness ot the user. In addition strong vibrations can also influence the quality of the screw connection.



Crimp terminal

At present the most perfect way to establish electrical connections is with crimp technique. Conductor and contact are exactly coordinated to each other, the crimping tool can be adjusted exactly to the conductor size. Therefore an electrical connection which is constant, reproduceable and independent from the user can be established. The crimping spot is gastight so that no oxygen can get in at the point of current passage. As a result any corrosion can be prevented and a constantly low contact resistance can be guaranteed.
Crimp connections can be established manually, semi-automatically or fully automatically. There are crimp contacts without stop spring, meaning that the stop spring is mounted into the contact carrier, and crimp contacts with stop spring, meaning the stop spring is mounted on the contact.

Crimping tools
see page 172



Insulation displacement technique

When using series B inserts with insulation displacement technique you simply insert the **unstripped** cable into the opened contact sleeve and push back the bladed slide with a screw driver - ready.

Coding

In addition to the known coding systems there is a simple and unexpensive plug-in coding part available.

Depending on the size of the pin or sleeve insert you can use 2, 4 or 8 coding parts.

Advantages

- No stripping of cables
- No wire end ferrules
- No screws

Saves up to 60 % connection time

- Proofpoint inside the slide
- No splitting of wires with flexible cables
- Compatible with series B screw or crimp inserts

Glass fibre cable connections

For industrial and plant automatization the decentralization in an integrated system also requires easily disconnectable power and control circuits. Master slaves take over peripheral tasks from plant parts which do not only have to be provided with power but which also must have a data connection to the control center.

There is a considerable ambient influence along the data line when data is transferred. Data may not be distorted or get lost. The use of glass fibre cables guarantees the maximum transfer of bulk data quantities.

Control techniques - like fieldbus systems - are increasingly using optocouplers for glass fibre cable transmission. Fieldbus structures may be divided into line-, ring-, star- or tree wiring. For glass fibre cable applications preferably star wiring is used in order to prevent signal losses. With Walther PROCON heavy duty connectors the periphery can be integrated in a disconnectable network of power and control, making it possible to transmit power and control in one unit, the control signals either through copper conductors or/and with glass fibre connection.
One unit for multiple systems.

For the optical data transmission in plants Polymer Optical Fibres (POF) are suitable. The attenuation will be about 0,3 dB/m at a wave length of 660 nm.

By comparison: pure quartz glass has 0,007 dB/m at a wavelength of 850 nm because of the much higher inhomogeneity of the plastic fibre.

With a transmission rate of 93,75 k bit/s to 1,5 M bit/s the usual bus requirements are completely covered. In view of electromagnetic compatibility and for short distances there is a wide range of application possibilities, especially for glass fibre cables.

Special features of transmissions with glass fibre cables

- galvanic isolation
- no potential compensating currents
- no interference from the outside
- high transmission rate and speed
- highest safety in the explosion-proof sector
- no magnetic disturbance
- small cable diameter and low weight
- very easy stripping of POF conductors

Technical Information

In General

The choice of connectors is not only determined by considering the current or voltage ratings, but also by their functionality and number of contacts. Importance is rather attached to the area of application and the prevailing installation conditions.
This means that depending on the installation conditions acc. to the standardization there can be different voltage and current indications for one connector.

Technical terms

➢ **Clearance**

Shortest distance in the air between two conducting parts (see DIN VDE 0110-1, section 1.3.2). The clearances are predetermined by the rated surge.

➢ **Creeping distance**

Shortest distance along the surface of an insulating material between two conducting parts (see DIN VDE 0110-1, section 1.3.3). The creeping distances are depending on the rated voltage, the pollution degree and the properties of the insulating materials.

creeping distance

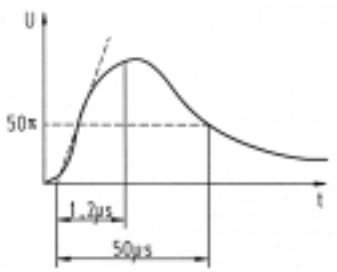
clearance

➢ **Rated voltage**

Fixed voltage value which working value and power value are referenced to. A connector may have more than one value or one rated voltage range.

➢ **Rated surge**

The rated surge is determined by means of the surge category and the rated voltage of a mains. It directly determines the value of the rated surge withstand capability tests of a connector *(voltage as waveform in 1,2/50 µs acc. to IEC 60 060-1).*



➢ **Rated current**

Fixed current (preferably at an ambient temperature of 40 °C) which a connector can permanently carry (without interruption) and which flows simultaneously through all its contacts which are connected to the largest possible conductors specified, whereas the upper limiting temperature is not being exceeded.
The dependence of the rated current on the ambient temperature is shown in the respective derating diagrams.

➢ **Transient surges**

Short-period surges with a duration of some milliseconds or less, oscillating or non-oscillating, normally highly damped (see DIN VDE 0110-1, section 1.3.7.2).
The surge can be caused by a failure, a switching operation, a lightning discharge, or it can be an intentionally generated surge which is necessary for the functioning of a device resp. component.

➢ **Withstand alternating voltage**

Is a surge as alternating voltage (50/60 Hz). For voltage proof tests it is applied for one minute. The test values in context with the rated surge are shown in the excerpt from table 8, DIN EN 61 984.

➢ **Test voltages** (DIN EN 61 984, excerpt from sheet 8)

Withstand impulse voltage kV (1,2/50 µs)	Withstand alternating voltage kV (50/60 Hz)
0.5	0.37
0.8	0.50
1.5	0.84
2.5	1.39
4	2.21
6	3.31
8	4.26
12	6.6

➢ **CTI value (Comparative Tracking Index)**

This value informs about the conductivity of insulating materials and affects the default value of creeping distances. The CTI value has an influence on the creeping distance. The higher the value, the shorter the creepage distance can turn out. By means of the CTI value plastics can be divided into insulation material groups.

Allocation of insulation material groups:

I	600 ≤ CTI
II	400 ≤ CTI < 600
IIIa	175 ≤ CTI < 400
IIIb	100 ≤ CTI < 175

➢ **Protection degree acc. to IEC 60 529**

The protection degree describes the proofness of housings, e.g. of electrical facilities. It ranges from IP 00 up to IP 68.
The standard protection degree of WALTHER industrial connectors is IP 65.

➢ **Derating-Diagramm acc. to DIN IEC 60 512**

The diagrams show the maximum current capacity of components. Display format is a curve showing the current in dependence of the ambient temperature. The current capacity is limited by the thermal properties of both contacts and insulating parts, having an upper limiting temperature which should not be exceeded.

➢ Pollution degree

The rating of appliances is depending on the ambient conditions. Eventually occurring pollutions affect their possible conductivity, combined with humidity they affect the insulating capacity of their surfaces. Over the creepage distance the pollution degree has an influence on the component construction. For open, unprotected insulations the pollution degree is defined by means of the ambient conditions.

WALTHER industrial connectors are per default laid out for pollution degree 3.

Pollution degree 1:
In air-conditioned or clean and dry rooms, e.g. computing machinery and measuring devices.

Pollution degree 2:
In housing spaces, sales offices and other business rooms, fine mechanical workshops, laboratories, proving grounds and medicinally utilized rooms. Due to occasional dewfall it has to be reckoned with a temporary conductivity of the pollution.

Pollution degree 3:
In industrial, commercial and agricultural enterprises, unheated storerooms, workshops, boiler houses and the electrical equipment of assembly machines or machine tools.

Pollution degree 4:
In outdoor places, e.g. devices on wagon ceilings of locomotives or tramways.

Excerpt from the DIN VDE 0110-1 resp. IEC 60 664-1, section 2.5.1:

Pollution degree 1:
No pollution or only dry, non-conducting pollution is occurring. The pollution has no influence.

Pollution degree 2:
Only non-conducting pollution is occurring. Occasionally, however, it has to be reckoned with temporary conductivity caused by dewfall.

Pollution degree 3:
Conductive pollution or dry, non-conducting pollution is occurring which becomes conductive because dewfall is to be expected.

Pollution degree 4:
The pollution leads to permanent conductivity caused by conductive dust, rain or snow.

➢ Surge category

The surge category is depending on the mains voltage and the mounting place of a device. It describes the maximum surge withstand capability of the device during a failure in the power supply system, e.g. in case of a lightning stroke.

The surge category influences the component dimensioning over the clearance. According to the standardization there are 4 surge categories.

Devices for industrial use, e.g. WALTHER industrial connectors, come under surge category III.

Excerpt of DIN VDE 0110-1 resp. IEC 60 664-1, section 2.2.2.1.1

Surge category I:
Devices which are meant for connection to the fixed installation of a building. Outside the device, measures have been taken to limit the transient surges to the respective value, either inside the fixed installation or between the fixed installation and the device.

Surge category II:
Devices which are meant for connection to the fixed electrical installation of a building; e.g. household appliances, portable tools and similar consumers.

Surge category III:
Devices which are part of the fixed installation and devices for which a higher degree of availablility is expected.
Examples: distribution boards, power switches, distributions (IEV 826-06-01, including cables, busbars, distribution boxes switches, sockets) in the fixed installation and devices for industrial use as well as stationary motors which are permanently connected to the fixed installation.

Surge category IV:
Devices which are determined for the use on or near the supply into the electrical installation of buildings, seen from the main distribution towards the mains.
Examples: electricity meters, overcurrent switches and ripple control devices.

Rated surges (DIN EN 61 984, table 5)

Rated voltage of the power supply system (≤ Rated insulation voltage of the equipment)					Preferred values for the rated surge in kV (1,2/50 µs)			
					Surge category			
					I	II	III	IV
Voltage phase-earth, deduced from the rated voltages of the mains for the alternating voltage (effective value) or DC voltage	Effective value of the DC voltage	Effective value of the alternating voltage	Effective value of the alternating voltage, DC voltage	Effective value of the alternating voltage, DC voltage	Special protected levels	Levels for electrical devices (household devices and others)	Levels for distribution circuits	Levels on the input of the system
V	V	V	V	V				
100	66/115	66	60	–	0,5	0,8	1,5	2,5
150	120/208; 127/220	115; 120; 127	110; 120	220-110; 240-120	0,8	1,5	2,5	4
300	220/380; 230/400; 240/415; 260/440; 277/480	220; 230; 240; 260; 277	220	440-220	1,5	2,5	4	6
600	347/600; 380/660; 400/690; 415/720; 480/830	347; 380; 400; 415; 440; 480; 500; 577; 600	480	960-480	2,5	4	6	8
1000		660; 690; 720; 830; 1000	1000	–	4	6	8	12

➢ Current-carrying capacity (Derating curve)

The checking of the current-carrying capacity of electrical-mechanical components is prescribed in the DIN IEC 512 T3. Each contact of the component must be able to withstand the specified current for 5 hours with the specified conductor size and a conductor length of at least 500 mm, without hereby exceeding the specified temperature rise compared with the ambient temperature.
The utilised materials determine the upper temperature limit. Thereby you get a parabolic base curve. Due to variations of both components and material properties this base curve has to be multiplied with the correction factor 0.8.

The connected conductor size determines the maximum permissible current.

The curves shown in the catalogue are already corrected curves. By means of these curves you can find out the permissible current which may flow simultaneously through each of the contacts. In practice, however, rarely all of the contacts are loaded equally. Thus it is possible to occasionally let flow higher currents, if less than 20 % of the entirety is loaded.

➢ Contact resistance

When connectors are used under maximum rating conditions the influence of the contact resistance is relatively low. Even extremely corroded silver-plated male and female contacts rarely cause any contact problems.

It is different with very small currents under extreme environmental conditions, like e.g. in electroplating works, tunnels, or when cellulose is being processed. The silver oxide layer on the surface of the contacts builds an electric resistance with capacitive, inductive and ohmic shares, and thus distorts the signal curves to such an extent that the subsequent receiver can no longer recognize the signals - considerable and hardly locatable troubles are the result. In such cases gold-plated contacts are recommendable.

With currents < 4 mA and voltages - 5 V gold-plated contacts should generally be used.

➢ Short circuit strength and high starting currents

Series	Short circuit current (A)					
	Overload duration (s)					
	0,1	0,25	0,5	1	2,5	5
D, DD	380	220	170	120	75	55
A3, 4	800	480	320	230	140	95
A, B, BV	1100	710	590	360	230	165
BA	3100	1700	1200	800	540	360

➢ Current-carrying capacity of copper conductors (in A)

Installation type ⇩ / Cross-section (mm²) ⇨	0.25	0.34	0.5	0.75	1	1.5	2.5	4	6	10
 **B 1 Conductors in protective conduits and installation channels**	-	-	-	7.6	10.4	13.5	18.3	25.0	32.0	44.0
 **B 2 Cables and lines in protective conduits or installation channels**	-	-	-	-	9.6	12.0	16.5	23.0	29.0	40.0
 **C Cables and lines on walls**	4.0	5.0	7.1	9.1	11.7	15.2	21.0	28.0	36.0	50.0
 **E Cables and lines on cable trays**	4.0	5.0	7.1	9.1	11.5	16.1	22.0	30.0	37.0	52.0

➢ Special provision for connectors

If certain preconditions are considered the standard for connectors offers the possibility to apply a lower pollution degree than that of the entire installation; i.e. that in an environment with pollution degree 3 connectors with the electrical data acc. to pollution degree 2 may be used. Basis hereof is the DIN EN 61 984, section 6.19.2.2.

Excerpt of the DIN EN 61 984, section 6.19.2.2

On a connector with minimum protection degree IP 54 acc. to IEC 60 529 the isolating parts inside the encapsulation may be rated for a lower pollution degree.

This applies also for connectors whose encapsulation is ensured by the connector housing and which are only separated for test/maintenance purposes.

The conditions are fulfilled by:

- a connector with minimum protection degree IP54 (IEC 60529)
- a connector built into a housing which is only separated for test/maintenance purposes as it is described in the standard
- a connector built into a housing which in separated condition is protected by a protective cap with at least IP 54.
- a connector inside a switch cabinet with at least IP 54.

A separated connector being exposed to industrial atmosphere for an undefined period of time does not belong to these conditions.

Please note that pollution can also act on the connector from inside a system.

➢ Choosing protection degree 2 for connectors

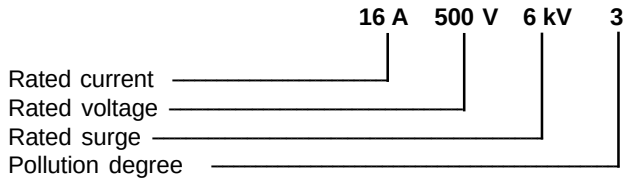
Application examples:

- Connector on a motor drive which is only separated once a defective motor is being exchanged, even if pollution degree 3 would otherwise be required for the system.
- Connectors on a modular built-up machine which are only opened for transport and serve for quicker mounting and safe putting into operation. During transport the connectors must be protected against pollution by means of protective caps resp. an adequate packaging of the system.
- Connectors within an IP 54 switch cabinet. Here you can even do without an IP 54 housing for the connector.

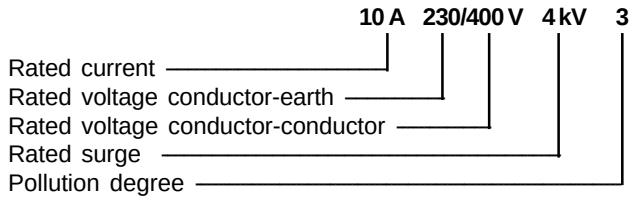
➢ Specifications of electrical data

The specifications of electrical data for connectors is made acc. to DIN EN 61 984.

Example of an identification for use in an unearthed mains or earthed delta mains (see page 193, table 5 of the DIN EN 61 984):



Example of an identification for exclusive use in earthed mains (see page 193, table 5 of the DIN EN 61 984):



➢ PG to M changeover

Basis for the changeover of our housings from the PG to the metric system is the international metric standard **DIN EN 50 262:** The PG range **PG 7 up to PG 48** is replaced by the metric range **M 12 up to M 63.**

The outside diameters of the threads do now correspond to the system measures of the mentioned standard - this means a considerable simplification: Now the thread designation concretely indicates the outside diameter in mm - M 20 for example stands for 20 mm outside diameter of the thread.

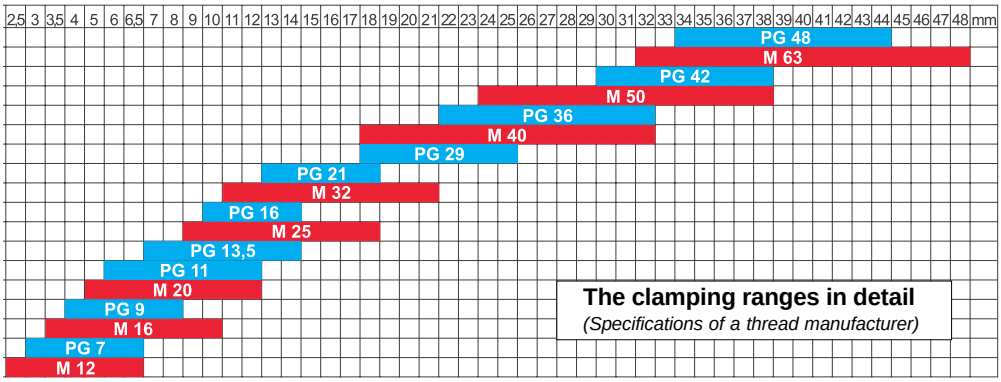
Housings with metric threads can be identified by the Ⓜ on the surface.

The following cross reference table from PG to M threads results from the given housing dimensions.

Cross reference table

PG	M
PG 11	
PG 13,5	M 20
PG 16	
PG 21	M 25
PG 29	M 32
PG 36	M 40
PG 42	M 50

As a result of the cross reference the maximum connectable cable diameters are becoming smaller due to the use of metric threads.



The clamping ranges in detail
(Specifications of a thread manufacturer)