

IP ingress protection of electrical thermometers

In accordance with DIN EN IEC 60529

WIKA data sheet IN 00.64

General information

To prevent the ingress of dirt, dust and water into electrical thermometers, different degrees of protection are required, depending on the application and customer requirements. These degrees of protection are standardised in the IP code in accordance with DIN EN IEC 60529.

Basics

DIN EN IEC 60529 provides a system for classifying the degrees of ingress protection for enclosures of electrical equipment. The "IPXY" marking is broken down as follows:

- Code letters IP: "Ingress Protection"
- First numeral (X): degree of protection against solid foreign bodies (including dust)
- Second numeral (Y): degree of protection against water

Additional and supplementary letters can also be used, but their use is optional.



IP test

Description

This document describes IP ingress protections that are used for electrical thermometers in standard versions from WIKA (Protection against penetration by dust and/or water).

Special versions with specific degrees of IP ingress protection are available on request.

This document serves as a supporting guide. However, it does not replace the obligation to review and observe DIN EN IEC 60529 and its corrections.

Specifications

Ingress protections against solid foreign bodies, defined by the first numeral

First numeral	Ingress protection		
	Short description	Definition	Test equipment
0	Not protected	-	No testing required
1	Protection against solid foreign bodies Ø 50 mm [1.97 in] and larger	The object probe, Ø 50 mm [1.97 in] sphere, must not enter fully ¹⁾	Rigid sphere without handle or guard Ø 50 +0.05/-0 mm [1.97 +0.002/-0 in]
2	Protection against solid foreign bodies Ø 12.5 mm [0.49 in] and larger	The object probe, Ø 12.5 mm [0.49 in] sphere, must not enter fully ¹⁾	Rigid sphere without handle or guard Ø 12.5 +0.2/-0 mm [0.49 +0.008/-0 in]
3	Protection against solid foreign bodies Ø 2.5 mm [0.1 in] and larger	The object probe, Ø 2.5 mm [0.1 in] sphere, must not enter fully ¹⁾	Rigid sphere without handle or guard Ø 2.5 +0.05/-0 mm [0.1 +0.002/-0 in]
4	Protection against solid foreign bodies Ø 1 mm [0.04 in] and larger	The object probe, Ø 1 mm [0.04 in] sphere, must not enter fully ¹⁾	Rigid sphere without handle or guard Ø 1 +0.05/-0 mm [0.04 +0.05/-0 in]
5	Dust-protected	Ingress of dust is not completely prevented. Ingress of dust must not affect the performance or safety of the device.	Dust chamber, with or without vacuum
6	Dust-tight	No ingress of dust	Dust chamber, with vacuum

1) The full diameter of the object probe must not pass through any opening in the enclosure.

Ingress protections against water, defined by the second numeral

Second numeral	Ingress protection		
	Short description	Definition	Test equipment
0	Not protected	-	No testing required
1	Protected against dripping water	Perpendicularly falling drops must have no damaging effects	Drip device: enclosure on turntable
2	Protected against dripping water when the enclosure is inclined to 15°.	Perpendicularly falling drops must have no damaging effects, when the enclosure is inclined to an angle of up to 15°, either side of perpendicular.	Drip device: enclosure in 4 fixed, 15°-inclined positions
3	Protected against sprayed water	Water that is sprayed at an angle of up to 60°, either side of perpendicular, must have no damaging effects.	Swivel tube: spraying ±60° from the vertical, maximum distance 200 mm [7.87 in] Spray nozzle: spraying ±60° from the vertical
4	Protected against splash water	Water that splashes against the enclosure from any direction must have no damaging effects.	Swivel tube: spraying ±180° from the vertical, maximum distance 200 mm [7.87 in] Spray nozzle: spraying ±180° from the vertical
5	Protected against water jets	Water directed against the enclosure from any direction in a jet must not have any damaging effect.	Jet nozzle Nozzle: Ø 6.3 mm [0.25 in] Distance: 2.5 ... 3 m [8.2 ... 9.8 ft]
6	Protected against water jets	Water directed against the enclosure from any direction in a strong jet must not have any damaging effect.	Jet nozzle Nozzle: Ø 12.5 mm [0.49 in] Distance: 2.5 ... 3 m [8.2 ... 9.8 ft]
7	Protected against the effects of temporary immersion in water	Under standardised pressure and time conditions, the water must not enter in a quantity that could have harmful effects.	Immersion tank Water level above the enclosure: 0.15 m [0.5 ft] from the top edge 1 m [3.3 ft] from the bottom edge
8	Protected against the effects of permanent immersion in water	The enclosure must not allow water to penetrate in harmful quantities when it is permanently immersed in water. The conditions agreed between the manufacturer and user must be stricter than those for numeral 7.	Immersion tank: Water level by arrangement

Second numeral	Ingress protection		
	Short description	Definition	Test equipment
9	Protected against high pressure and high water jet temperatures	Water that hits the enclosure from all directions under high pressure and at high temperatures must not cause any harmful effects.	Flat spray nozzle: Testing of smaller enclosures on a turntable (5 ±) rpm Spraying from 0°, 30°, 60°, 90° or Testing of larger enclosures by spraying from all practical directions as expected for the intended use.

All data for the second numeral are based on water as the test medium.
Use of the devices in other media will invalidate the guarantee/warranty claim.

Notes on IP ingress protection:

There is often a misunderstanding that a higher second numeral automatically means higher IP protection. This assumption applies to ingress protection classes from IPx0 to IPx6. However, for ingress protection classes IP67 and IP68, the test items are immersed in water. The test parameters and conditions applied here are not comparable with those of the tests up to IP66. Ingress protection IP69 must also be considered separately.

Extract from the second revision of DIN EN IEC 60529 from June 2019:

“An enclosure designated only with the second index number 7 or 8 is considered unsuitable for exposure to water jets (designated with the second index number 5 or 6) and does not have to fulfil the requirements of numbers 5 or 6, unless it is a multiple designation. An enclosure designated only with the second index number 9 is considered unsuitable for exposure to water jets (designated with the second index number 5 or 6) and for immersion in water (designated with the second index number 7 or 8) and does not have to fulfil the requirements of numbers 5, 6, 7 or 8, unless it is a multiple designation.”

Thermometer designs

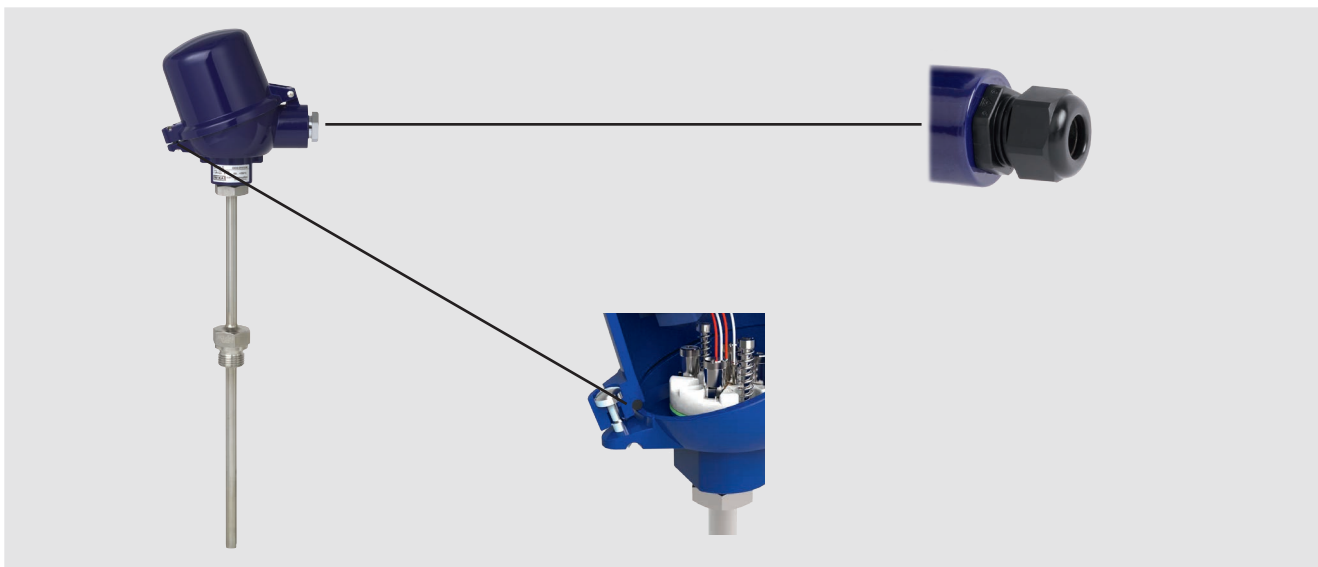
With a few exceptions, all electrical thermometers from WIKA fulfil at least IP54. IP65 is the standard for many instrument versions. For instruments with form A connection heads (large straight thermocouples), a maximum of IP53 is possible. The data sheets of the corresponding models provide information on their standard IP protection.

Water or dust can penetrate electrical thermometers at various points.

Instruments with a connection head

Seal at the connection head

A ring-shaped seal in the cover of the connection head and a suitable cable gland prevent the ingress of dust and water.



Sealing at the connection point of the thermowell/protection tube / neck tube to the connection head

The thermowell/protection tube is screwed to the connection head or neck tube, which means that IP65 ingress protection is usually achieved without any problems. A suitable ring-shaped seal and, if necessary, PTFE sealing tape are used.



Connection head without sealing

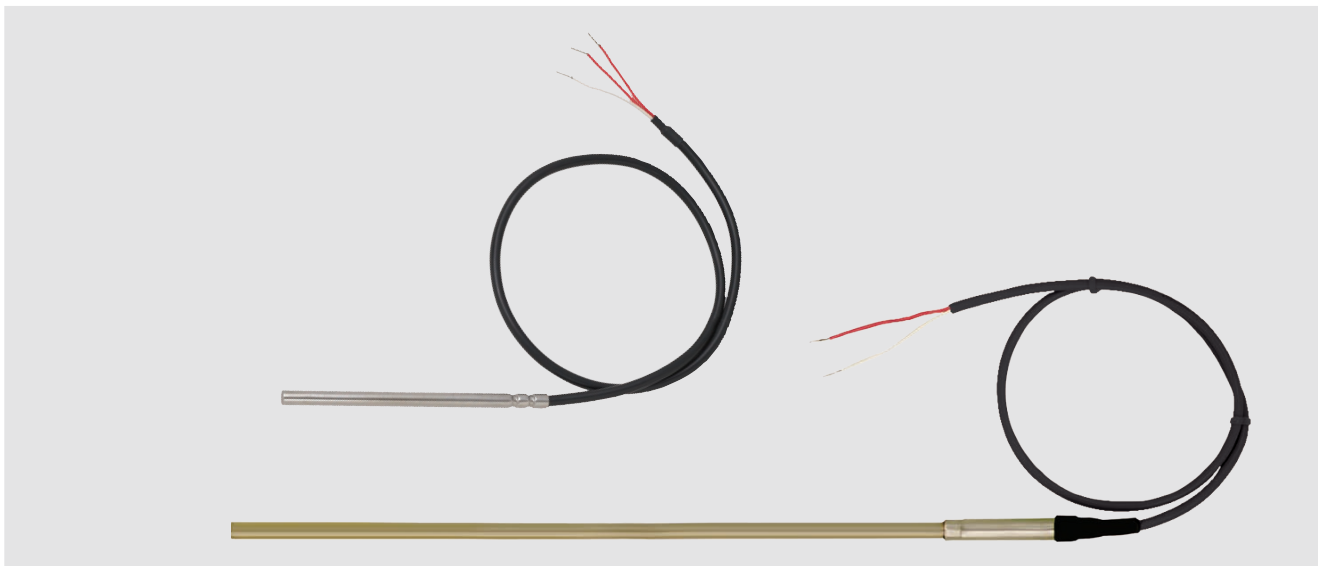
For large straight thermocouples in accordance with DIN 43733, form A connection heads are predominantly used. The protection tube or support tubes inserted into the underside of the head are fixed at the side with two screws. Due to the gap between the head and tube in these designs, ingress protection IP53 is achieved.



Instruments with connection cable

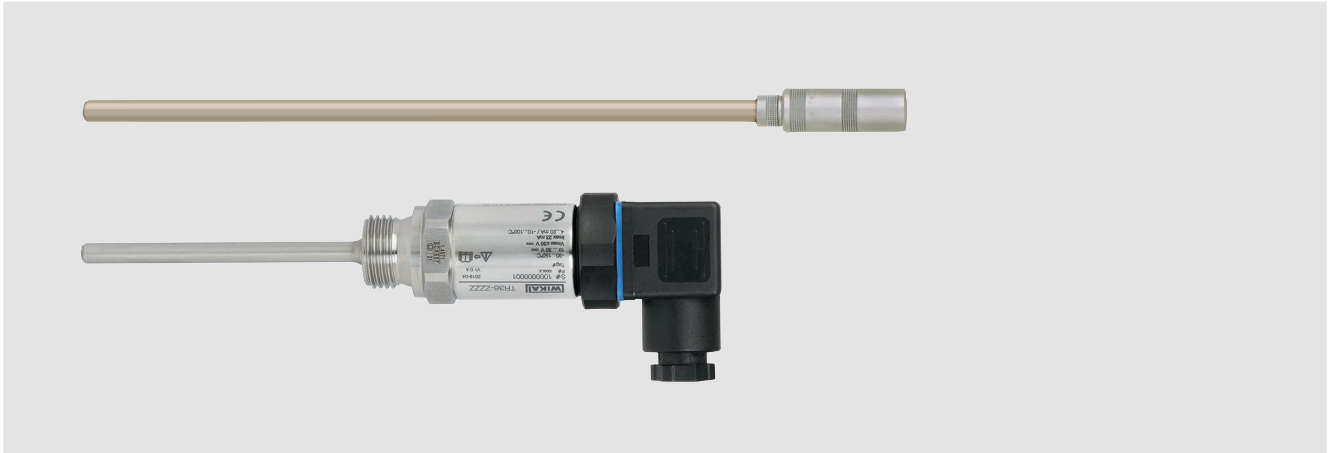
Sealing at the connection point of the cable and the probe

Standard IP ingress protection of cable probes is IP54. Certain instrument versions can be manufactured up to IP66.



Abdichtung an den Komponenten der Anschlussstecker

Thermometers can be manufactured with an attached connector. The IP ingress protection specifications of the connector manufacturer are decisive here.



A coupler connector can also be located at the end of an assembled cable. In general, the specified ingress protection only applies when plugged in with cable connectors of the corresponding ingress protection. Exceptions are described in the data sheets of the corresponding instruments.

Instruments with wireless transmission

At the connection point of the upper and lower body of the enclosure

Standard IP ingress protection of these probes is IP65/IP67.

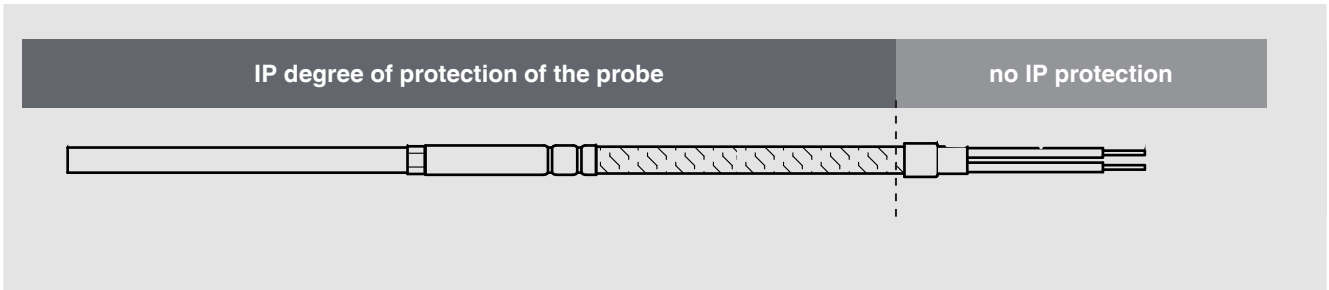


The degrees of protection specified in this document apply under the following conditions:

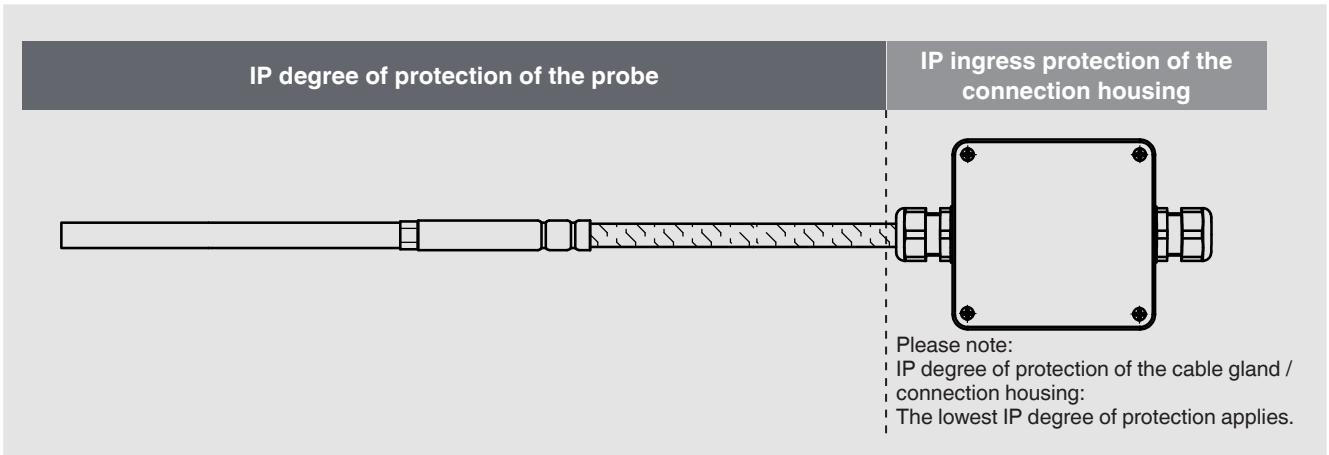
- Use of a suitable cable gland
- Use of a cable cross-section appropriate for the gland or ensuring the appropriate cable gland for the available cable
- Adhere to the tightening torques for all threaded connections
- Use of a suitable mating connector

Classification of the IP ingress protection zones of the probe

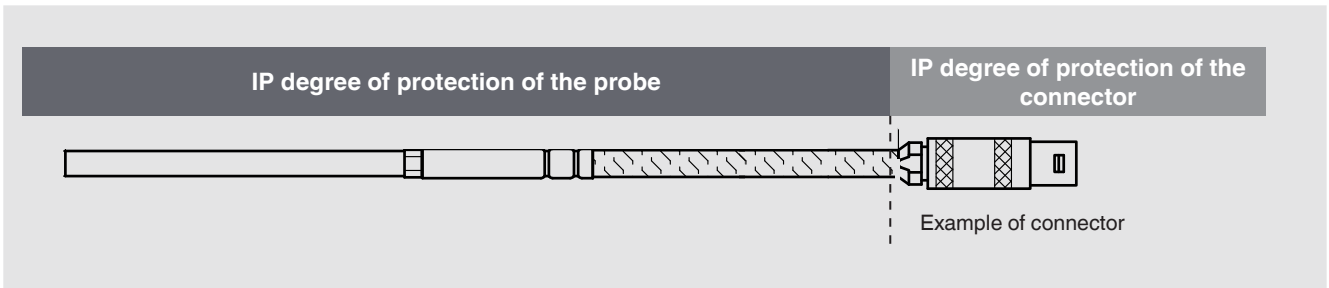
Version with connection cable



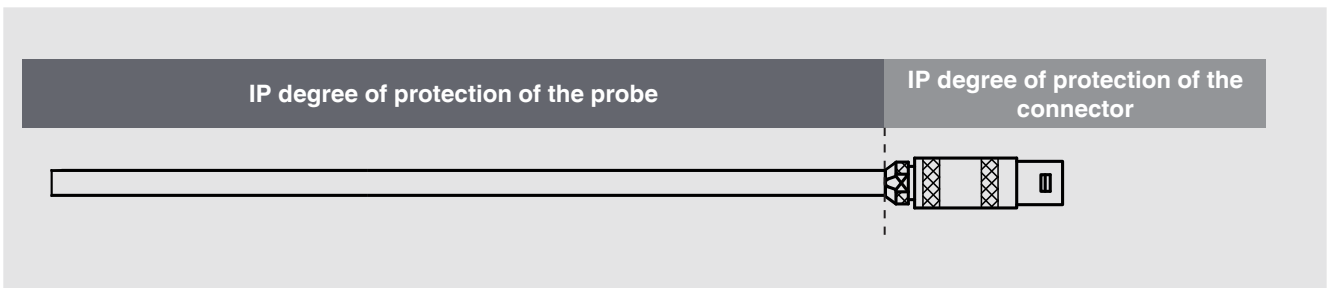
Version with connection housing, fitted at the cable end



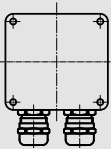
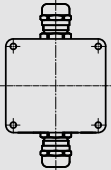

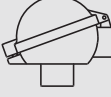


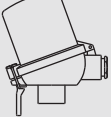
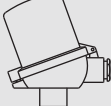



Version with connector, fitted at the cable end


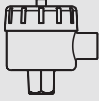
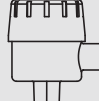
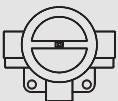
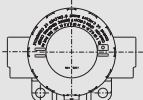
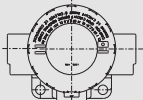
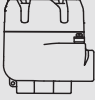
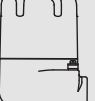



Version with connector, fitted at the MI cable


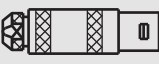
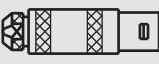

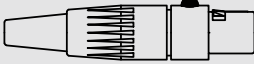


IP ingress protection types of the connection housing

Model		IP ingress protection
	Field case, 80 x 82 x 55 mm (L x W x H), plastic (ABS), inputs on one side	IP65
	Field case, 80 x 75 x 57 mm (L x W x H), aluminium, inputs on one side	
	Field case, 82 x 80 x 55 mm (L x W x H), plastic (ABS), inputs on opposite sides	
	Field case, 80 x 75 x 57 mm (L x W x H), aluminium, inputs on opposite sides	
	KN4-A, aluminium, screw-on cover	IP65
	KN4-P, polypropylene, screw-on cover	
	BSZ, aluminium, circular, hinged cover	
	BSZ-K, polyamide, anti-static, circular, hinged cover	
	BSZ-H, aluminium, raised hinged cover	
	BSZ-H, aluminium, raised hinged cover, with digital temperature display	
	BSS, aluminium, circular, hinged cover, clamping lever lock	
	BSS-H, aluminium, raised hinged cover, clamping lever lock	
	BSZ-HK, polyamide, anti-static, raised hinged cover	
	BVS, stainless steel, screw-on cover	
	BVC, stainless steel, screw-on cover	IP68
	JS, aluminium	IP65

Model		IP ingress protection	
	1/4000, aluminium, screw-on cover	IP66	
	1/4000, stainless steel, screw-on cover		
	7/8000, aluminium, screw-on cover		
	7/8000, stainless steel, screw-on cover		
	7/8000, aluminium, screw-on cover, with digital temperature display		
	7/8000, aluminium, screw-on cover, with digital temperature display		
	5/6000, aluminium, screw-on cover		
	5/6000, stainless steel, screw-on cover		
	5/6000, aluminium, screw-on cover, with digital temperature display		
	5/6000, aluminium, screw-on cover, with digital temperature display		
	Field transmitter TIF50		IP66
	PIH-L, aluminium, flat screw-on cover		IP66
	PIH-H, aluminium, raised screw-on cover		
	PIH-W, aluminium, raised screw-on cover, with digital temperature display		

IP ingress protection types of the connector

Connector ¹⁾		Version	IP ingress protection
	Binder screw connector (male)	Series 680	IP40
		Series 692	
		Series 423	
	Amphenol screw connector (male)	C16-3	IP40
	Lemos connector (male)	Size 0 S	IP50
		Size 1 S	
		Size 2 S	
		Size 1 E	IP65
	Harting connector (male)	7D	IP65
		8D	
		8U	
	XLR mini connector (female)	3-pin, 4-pin, miniature	IP65

Connector ¹⁾		Version	IP ingress protection
	Binder screw connector, M12 x 1 (male)	4-pin	IP65
	Thermo-connector (male)	2-pin, standard/miniature	IP00
		3-pin, standard/miniature	

1) The figures are not to scale.

IP ingress protection for the cable inlets

Cable inlet		Max. IP ingress protection IEC/EN 60529
	Standard cable inlet	IP65
	Plastic cable gland (cable Ø 6 ... 10 mm)	IP66
	Plastic cable gland (cable Ø 6 ... 10 mm), Ex e	IP66
	Nickel-plated brass cable gland (cable Ø 6 ... 12 mm)	IP66
	Nickel-plated brass cable gland (cable Ø 6 ... 12 mm), Ex e	IP66
	Stainless steel cable gland (cable Ø 7 ... 12 mm)	IP66
	Stainless steel cable gland (cable Ø 7 ... 12 mm), Ex e	IP66
	Plain threaded	IP00
	2 x plain threaded	IP00
	Junction box, M12 x 1 (4-pin)	IP65
	Sealing plugs for shipping	-

NEMA (National Electrical Manufacturers Association)

Classification of NEMA types in accordance with NEMA 250	
1	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection against falling dirt.
2	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment, to provide a degree of protection against falling dirt, and to provide a degree of protection against dripping and light splashing of liquids.
3	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust - and that will be undamaged by the external formation of ice on the enclosure.
3 R	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt, rain, sleet, and snow - and that will be undamaged by the external formation of ice on the enclosure.
3 S	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust - and in which the external mechanism(s) remain operable when ice laden.
4	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, and hose-directed water - and that will be undamaged by the external formation of ice on the enclosure.
4 X	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, hose-directed water, and corrosion and that will be undamaged by the external formation of ice on the enclosure.
5	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt - against settling airborne dust, lint, fibers, and flyings - and to provide a degree of protection against dripping and light splashing of liquids.
6	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt - against hose-directed water and the entry of water during occasional temporary submersion at a limited depth - and that will be undamaged by the external formation of ice on the enclosure.
6 P	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt - against hose-directed water and the entry of water during prolonged submersion at a limited depth - and that will be undamaged by the external formation of ice on the enclosure.
12	Enclosures constructed (without knockouts) for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt - against circulating dust, lint, fibers, and flyings - and against dripping and light splashing of liquids.
12 K	Enclosures constructed (with knockouts) for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt - against circulating dust, lint, fibers, and flyings - and against dripping and light splashing of liquids.
13	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment - to provide a degree of protection against falling dirt - against circulating dust, lint, fibers, and flyings - and against the spraying, splashing, and seepage of water, oil, and noncorrosive coolants.

Comparison of NEMA types and DIN EN IEC 60529 ingress protection types

NEMA types		DIN EN IEC 60529 Ingress Protection	
1	Covers	IP20	The reverse view from IEC to NEMA is not permissible, as the NEMA tests are more extensive than the IEC tests.
2	Covers	IP22	
3	Covers	IP55	
3 R	Covers	IP24	
3 S	Covers	IP55	
4	Covers	IP66	
4 X	Covers	IP66	
5	Covers	IP53	
6	Covers	IP67	
6 P	Covers	IP68	
12	Covers	IP54	
12 K	Covers	IP54	
13	Covers	IP54	

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