

IP69K RATED

Control Devices & Indicator Lights

Industrial-Grade Joystick Controls



 **SCHMERSAL**
Turning Workplaces Into Safe Places[®]
& Clean[^]

Rated IP69K Ingress Protection to 1450psi at 175° F

Designed for Food Processing, Pharmaceutical, Medical Equipment, Marine, Construction Equipment & Outdoor Applications

Recognizing that certain industrial grade controls are subject to heavy-duty cleansing conditions in food processing, pharmaceutical, petro chemical, medical OR, marine, trash hauling and construction industries, DIN 40050-9 has extended the IEC 60529 rating system to IP69K for high-pressure, high-temperature wash-down applications. This rating provides waterproofing protection that exceeds NEMA 4X rating. Control enclosures must be more than dust tight (IP6X). They must also withstand high-pressure and steam cleaning and meet the requirements of IP65 and IP66.

To meet this challenge, Schmersal has developed a family of controls that features hostile-resistant enclosures with special seals that can tolerate and stand up to caustic cleaning solutions without degradation, thereby maintaining reliability and prolonging product life. The Schmersal IP69K safety controls have been designed with extra smooth surface contours; this eliminates any

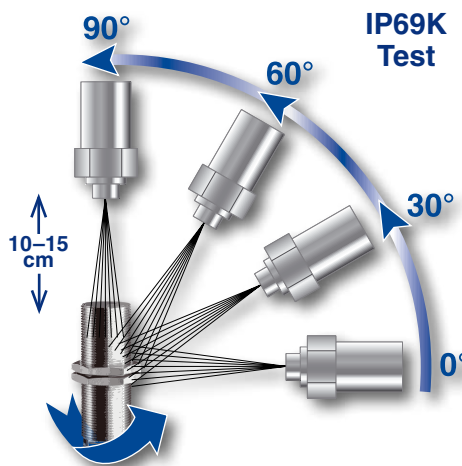
possible hiding places for food and other particles that might promote bacterial growth.

For more than half a century Schmersal has been a worldwide leader in the development and manufacturing of man-to-machine safety controls; hygienic and food safety is a logical extension of this focus.

This catalog is devoted primarily to our N-Series control devices, indicators and spring-return industrial-grade K-Series joystick controls. These are just two types of devices which are part of a comprehensive group of IP69K rated controls which also includes type 4 light curtains, pulse-echo based safety sensors, and stainless steel coded-magnetic safety sensors which comply with stringent IEC 60529 rating

system. (See back cover and Schmersal web site for more details.)

Contact us today and let our experience guide you to a cleaner, safer workplace.



Important note:

The devices in this range are not intended for private consumers, i.e. they are not consumer products within the meaning of the European Directives (in Germany within the meaning of § 5 GPSG) or other national laws. Assembly and commissioning of the devices require personnel with appropriate electrical know-how or who have been suitably instructed.

Subject to technical modifications and error. The data specified in this catalog are carefully checked typical standard values.

Descriptions of technical correlations, details on external control units, installation and operating instructions or similar have been provided to the best of our knowledge. However, this does not mean that any warranted characteristics

or other properties under liability law may be assumed which extend beyond the "General Terms of Delivery of Products and Services of the Electrical Industry".

We trust you will understand that the user must check our information and recommendations before using our equipment.

Ask for Catalog GK1 for information about non-IP69K CE-compliant machine guarding safety products.

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• 22.3 mm Diameter Installation (30 mm adapters available ... see page 56)

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N SERIES Control Devices and Indicator Lights for Food Processing, Pharmaceutical, Medical, Marine, and Outdoor Equipment Applications

Application Flexibility

A number of special design features and properties make this range of control devices and indicator lights (installation diameter: 22.3 mm) suitable for the following applications:

Food Processing, Pharmaceutical and Medical Applications

- **in the type series N** applications in food processing machines to comply with the special cleaning requirements of this industry and to prevent the hygiene risk of cross-contamination, particularly with respect to machines processing raw goods, such as fish, meat, poultry, milk or eggs; also ideal controls for pharmaceutical and medical equipment.

Marine & Outdoor Applications

The **type series N** is furthermore suitable for applications with high requirements as to the sealing capacity of the device heads (with IP 69K type of protection), for example, for control input panels and command panels in the outdoor area on ships, commercial vehicles, in traffic systems etc. or in extremely dusty and dirty environments, as in the case of tunnel drilling machinery.



Design & Testing

The range* has been designed under analogous consideration of EN 1672-2 "Food Machinery – General Design Principles – Part 2: Hygiene Requirements", as documented by a prototype test with the "hygiene" test certificate of the Prüfstelle der Fleischerei-Berufsgenossenschaft im BG-Prüfzert

(Testing Agency of the Employers' Liability Association for the Butcher's Trade).

In addition to the advantages of the IP 69K

Hygiene type of protection (refer to page 3) and the cleaning friendly shapes of the device heads the following features deserve additional mention in terms of hygienic conformance design:

* Refer also to:

- Page 7: Special design features in detail/
- Page 8/9: Background information on the subject of "hygienic-conformance design"

- Special seals extensively prevent the penetration of product residue in the gaps between the fixed and moving device parts, thereby effectively preventing the formation of bacteria nests in places which cannot be accessed for cleaning.

- Easy to clean due to

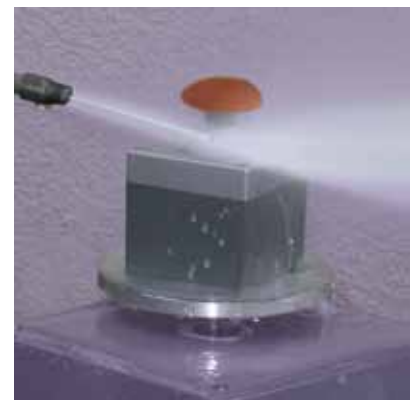
- smooth surfaces and the extensive avoidance of areas on which residue could collect
- selection of materials resistant to cleaning agents typical in the food processing industry such as smoke resin removers.

- Use of food-compatible materials only as a matter of course.

Control devices and indicator lights of the type series N also are UV- or ozone-tolerant.



Hygiene



Common design features and properties

- **Type of protection IP 67/ IP 69K**

All device heads satisfy the protection type tests

- IP 67 to EN 60 529 (including protection from the penetration of water when constantly submersed, tested at 1 m water column/30 min.), and

- IP 69K to DIN 40050, Part 9 (1983)

- **Type of protection IP 69K**

In addition to the test for dust-tightness the test for IP 69K (originally conceived as a protection type test for

road vehicles) simulates the resistance of devices to high-pressure water cleaners by subjecting the test subjects to a hot (approx. 80 °C) water jet at very high pressure (approx. 100 bars) at 5 revolutions per minute without any damage occurring.

- **Easy to clean**

The special shape of the devices, in which corners and edges are largely avoided and smooth surfaces have been created, make cleaning of the device heads simple and effective.

- **Industrial compliance**

The devices, in connection with the long-time well-ried contact and light terminal blocks EF/EL, satisfy the requirements placed on industrial control devices and indicator lights to IEC EN 60 947-5-1 (VDE 0660 Part 200) as well as IEC EN 60 947-5-5 (VDE Part 210) and EN 418 and the in future ISO EN 13 850* in the case of EMERGENCY STOP control devices.

- **Design**

The range was given the "IF award winner 2003".



design award
winner
2003



Product range/accessories

The range consists of the following commercially available types of devices:

- pushbuttons
- illuminated pushbuttons with LEDs
- maintained selector switches with 2 and 3 positions and short and long knobs
- ditto, spring return selector switches
- mushroom pushbuttons
- EMERGENCY STOP control devices
- high and flat indicator lights with LEDs

The range also includes the following (refer also to page 4 et seq.):

- rotary disconnects
- short-lift pushbuttons
- potentiometer drives
- 2- to 12-step maintained selector switches
- blanking plugs
- a so-called selector switch inhibit

- adapters with position switches (for type of protection IP 65/IP 67 behind the front plate)
- accessories, e.g. labels and protective collars
- adapter rings (installation diameter 30.5 → 22.3 mm)
- V4A mounting boxes (command boxes).



Design features of individual devices



Illuminated devices (for product range refer to pages 19 (illuminated pushbuttons)/ 28 et seq. (indicator lights))

For reasons of hygiene and sealing illuminated pushbuttons and indicator lights are designed in such a way that it is not possible to replace a bulb from the front (from the front side of the front panel). For this reason LED-based versions are available (LEDs with an expected serviceable life > 10.000 hours compared with bulbs < 1,000 hours).

Special light terminal blocks (ELDE) with integrated "superbright" multi-LEDs are offered for both types of devices. Alternatively, LEDs with Ba9S holder (refer to accessories, page 55) can also be used in connection with light terminal blocks of the ELE type, which in this case only act as voltage supply.

Furthermore, indicator lights with "superbright" LEDs are available which are integrated into the device head to provide illumination over the entire surface.



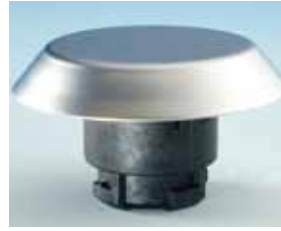
Lockable maintained selector switch mounting frame as substitute for the key-operated maintained selector switch (refer to page 22 for product range)

This mounting frame, consisting of a type of lid with an inner-lying cam and a fixed hole, provides a functionality similar to a key-operated maintained selector switch when combined with a maintained selector switch. The cam inside the lid fixes the desired switched state. It is locked by means of one or two padlocks.

The mounting frame is designed such that it complies with hygiene requirements. The padlocks used are to be viewed separately.

Key-operated maintained selector switches and key-operated selector spring return selector switches are not featured in the product range for reasons of hygiene and sealing.

Lockable maintained selector switch mounting frame as main switch substitute On request.



Blanking plug (refer to page 56 for product range)

Unused holes in an operating or control panel can be closed using this accessory. The design of the blanking plug also satisfies the sealing requirements of IP 67/IP 69K and the demands placed on a hygienic conformance design.

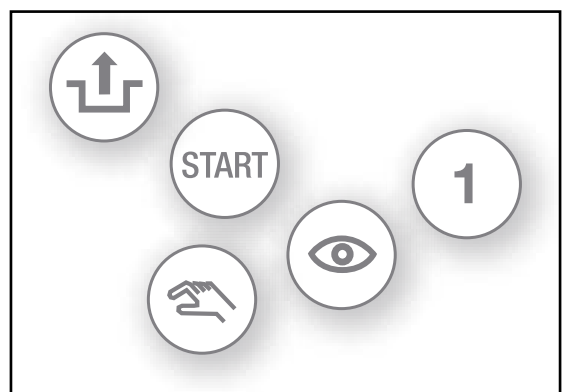
Adapter ring (refer to page 56 for product range)

The adapter ring (transition ring) permits devices of the N series to be used in installation bore holes with a diameter of 30.5 mm without affecting the design features and properties.

Symbols (refer to page 60 et seq. for product range)

Symbols can be attached to the devices by means of tampon printing on the button surface with a single component paint. The print is then stoved to increase wear resistance. From the point of view of hygiene the colors used are safe if used correctly.

Hot embossing: on request.





Step switches with 2 to 12 switching positions

(refer to page 40 et seq. for product range)

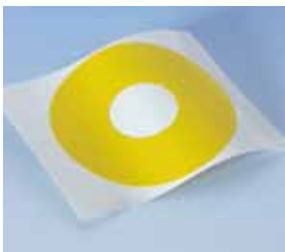
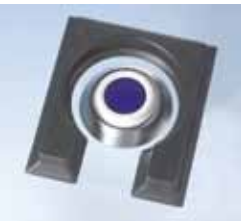
Step switches with 2 to 12 switching positions consist of a maintained selector switch device head and contact block in cam-operated design with locating mechanism.

Protective collar

(refer to page 58 for product range)

Labels

(refer to page 57 for product range)



Potentiometer drives

(refer to page 42 for product range)

This device consists of a fluted knob and potentiometer receptacle with integrated mounting flange. The potentiometers themselves are not part of the product range.

Short-lift pushbuttons

(refer to page 49 et seq. for product range)

In order to facilitate fatigue-free work with frequent actuation of pushbuttons, so-called short-lift pushbuttons supplement the product range. The actuation of the devices is limited to an ergonomic-friendly 2 mm switching lift with an actuating force of approx. 15 N.

The short-lift pushbuttons operate on the basis of an electromechanical principle of action and are available as NC/NO contact combination (3 ... 50 V, max. 100 mA, NC contacts not positively opening).



Adapter with position switches

(refer to page 43 et seq. for product range)

For applications in which a high class of protection is also required behind the front plate, an adapter is available for the connection of position switches with type of protection IP 65 and IP 67 from the Elan SEK type series (position switches to EN 50 047, shape B, vertical plunger).

Actuating heads for the adapter solution include pushbuttons, mushroom buttons, single-plunger maintained and spring return selector switches as well as EMERGENCY STOP control devices (without EFR spring element). Here too a choice of device heads can be made between the N type series and O type series.

SEK position switches are offered as 2-pole version with snap-action contacts (1 NC/ 1 NO contact, 2 NC contacts, 2 NO contacts). Three-pole versions on request.



Design features of individual devices (continued)



Mounting boxes (control boxes)

(refer to page 63 et seq. for product range)

Control boxes made of a special V4A material are available, particularly to supplement the N type series. In the same way as the control devices and indicator lights of this product range, these control boxes satisfy the basic requirements placed on a hygienic conformance design, i.e.

- they are extensively designed without corners and edges with radiuses >6 mm
- they satisfy the type of protection IP 67 and IP 69K, and

- they have been manufactured using NIROSTA 1.4571 (AiSi316Ti), a deep-drawn material specially for use in food processing machines.

The boxes are also suitable for other applications outside the hygiene-critical area with high environmental stress and sealing requirements as are typical for devices of the N type series.

The control boxes are offered in three versions for 1, 3 and 5 control points.

EF/EL terminal block system

(refer to page 30 et seq. for product range)

The N type series the EF/EL system is offered as standard for contact and light terminal blocks (for exceptions refer to device descriptions). This is a modular system consisting of individual blocks snapped on to an mounting flange. The contacts are characterised by their suitability for very small voltages (switching currents ≥ 5 V/ 3.2 mA).

On request: contacts with 5 μ m hard gold plating in aggressive ambient conditions, e.g. in sewage treatment plants (ammonia).

The following connections are available:

- screw terminals (1-pole/2-pole elements)
- flat-pin plugs (1-pole/2-pole elements)
- WAGO Cage Clamp terminals (1-pole/2-pole elements)



Application information



Warning! It must be ensured by organizational measures that devices with damaged or destroyed seals are replaced immediately.



Warning! The devices are not suitable for so-called "vandal-proof" applications.

Mounting instructions

Refer to page 12 et seq. and the respective device types.

Cleaning agent suitability

The device heads of the N type series have been subjected to different tests with commercially available cleaning agents. This includes a resistance test on the N type series to smoke resin remover (= submersion in a test liquid consisting of 10% smoke resin remover, 90% water for 7 days) without any impairment to appearance or function (refer here to resistance table on page 38).

Test conditions

All tests were successfully performed under standard or laboratory conditions. However, due to differences in practical application deviating results cannot be ruled out.

Special design features in detail



The special sealing measures (1), the special device shapes (2) and the choice of material (3) are based on the following design features:

(1) Device sealing

Specially designed seals serve to protect against the penetration of dirt and bacteria in the gaps between fixed and moving parts of the device.

A: In the case of pushbuttons, mushroom buttons and EMERGENCY STOP control devices, i.e. in the case of axially operated actuators, this seal is permanently fixed to the bezel and actuators via corresponding receptacles, thereby closing open gaps to the outside.

B: In the case of rotating actuators, e.g. in the case of maintained and spring return selector switches, the device seal is designed in such a way that while it is only attached to the actuators on one side, it reaches over the bezel, assisted by the bell shape, i.e. when the actuator is turned a hygiene-critical gap does not form. An additional seal inside the device also protects against the penetration of pressurised water.

C: All devices feature an additional front plate seal.

(2) Device shape

The special thought given to making the devices easy to clean are reflected

- in the bezel design
- the design of the outer surfaces of the device seals, and
- in the design of the actuators.

D: The bezel on the device sleeve is designed in such a way that the front plate and the outer surface of the bezel are at an angle of approx. 135° to each other, thereby creating a surface without “sharp” transitions. Owing to the fact that the bezel with the front plate seal lies flush on the front plate there is little surface area for dirt and bacteria to collect (another advantage).

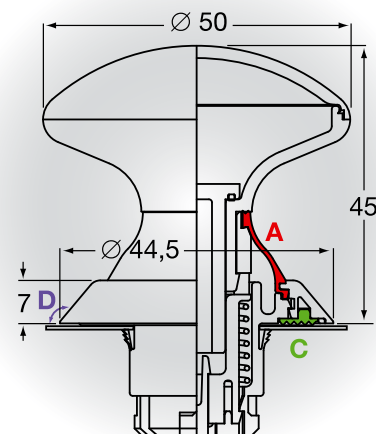
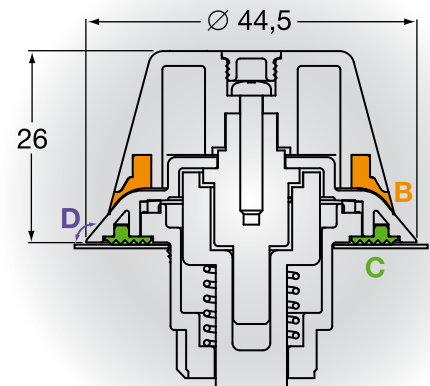
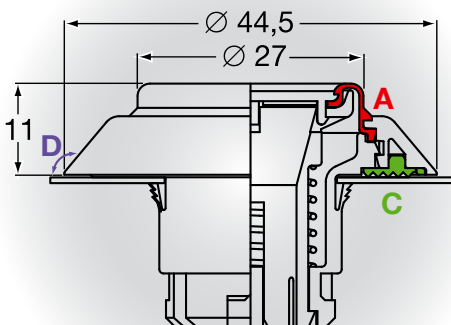
The outer surfaces of the device seals make a flush (in the case of pushbuttons and indicator lights) or continuous (in the case of other device versions) transition from the bezel to the free outer surface of the actuator, i.e. a smooth transition is formed here too. The same applies to maintained and spring return selector switches, the only difference being that the seal is tensioned in the actuator here and reaches over the bezel.

The actuators of all devices with grip or mushroom shape have curvature radiuses ≥ 3.2 mm at all corners and edges similarly for reasons of ease of cleaning. Furthermore, a distance which is always larger than a finger width is maintained to the fixing surface in order to guarantee ease of cleaning by hand.

(3) Choice of material

All external parts of the control devices and indicator lights of this programme are made of thermoplastics. These materials are approved in accordance with the European directives for use in food processing. These are commercially available materials such as PA; PC, POM, NBR and ABS.

The bezels are galvanically matt chromed (ABS), making their surfaces smooth and easy to clean. The other parts are highly closed-pore, thus making them also easy to clean.



Background information on the subject of “hygienic-conformance design”

Background¹

Irrespective of the large number of statutory, standard and other provisions the subject of hygiene has been important at least since 1995 as a subject for the EC Machine Directive and thus a subject of machine safety which affects the food processing industry in particular.

This subject has been incorporated in the “Basic Safety and Health Requirements in the Design and Construction of Machines and Safety Components”² and permits the conclusion to be drawn that the hygiene regulations serve two purposes:

- They are intended to protect employees from infection and disease (health protection of the employees).
- They are also intended to prevent the product becoming contaminated by the machine (consumer protection).

1 Partly quoted from: Special publication of the Berufsgenossenschaft Nahrungsmittel und Gaststätten, Prüf- und Zertifizierungsstelle Mannheim, from Handbuch Maschinessicherheit, Ausgabe 01/96, Kapitel 5.30, Wockert: Hygienegerechte Konstruktion von Nahrungsmittelmachines

2 Refer to EC Machine Directive, Appendix 1, Section 2.1: Basic Safety and Health Requirements for Specific Machine Equipment – Food Processing Machines



Harmonised standards within the meaning of the EC Machine Directive on the subject of “hygiene”:

- EN 1672-2: Food-processing machines – General Principles of Design – Part 2: Hygiene Requirements
- ISO 14 159: Hygiene Requirements on the Design of Machines



Basic requirements of hygienic-conformance design

Two areas must be considered with respect to the hygiene requirements placed on machines (and also on other technical aids). Firstly, the suitability of materials and secondly the hygienic conformance design, the principles of which can be summarised as follows:

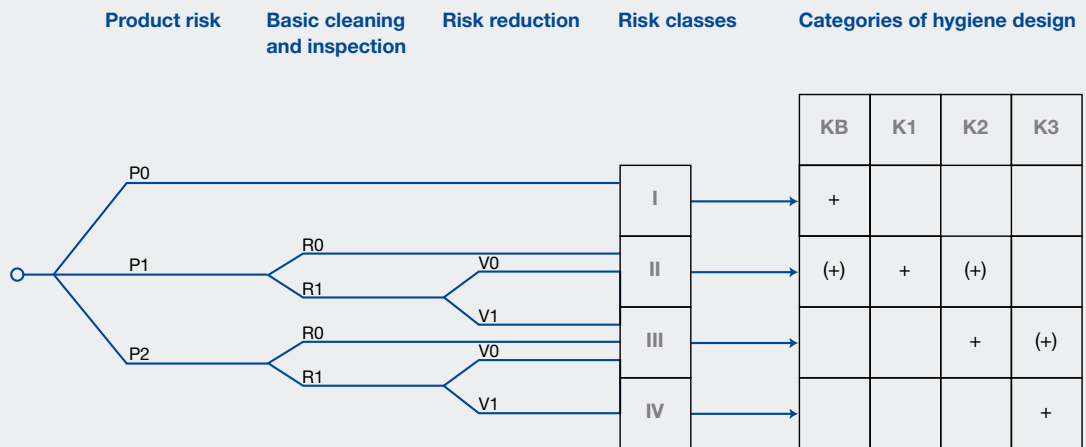
- Surfaces and their transitions must be sufficiently smooth.
- Connections must be conceived in such a way that protruding parts, strips and concealed corners are restricted to a minimum.
- The connections of inside surfaces must be made with curves of sufficient diameter.
- Operating materials (e.g. lubricants) may not come into contact with food if these substances are not food-compatible.
- Fluids (food and cleaning agents) must be able to flow from the machine at least in cleaning position.
- Any surfaces coming into contact with food must be easy to clean.
- Areas which are inaccessible to cleaning must be sealed against the penetration of organic substances.

Application of preference

Control devices and indicator lights of the N type series have been developed for food processing machines with command entries and command panels the operation of which is associated with the risk of cross-contamination or which are integrated into parts of machines which required extensive or systematic application of the basic hygiene principles (= hygiene categories K2 and K3 in accordance with the "Risk chart showing the hygiene risk in food processing machines").



Risk chart showing the hygiene risk in food processing machines, proposal of the Berufsgenossenschaft für Nahrungsmittel und Gaststätten, Test and Certification Agency, Mannheim (refer to page 66 et seq.)



Risk chart showing the hygiene risk in food processing machines

+ = expedient category
 (+) = possibly expedient category

P Product risk

- P0 Products with low hygiene-sensitivity
- P1 Product with moderate hygiene-sensitivity
- P2 Products with high hygiene-sensitivity

R Basic cleaning and inspection

- R0 Critical points visible and easy to reach
- R1 Critical points difficult to see and reach

V Risk reduction

- V0 Risk reduction factors present
- V1 No effective reduction of risk

K Categories of hygiene design

- KB Basic measures
- K1 Basic measures and application of basic hygiene principles insofar as practicable
- K2 Basic measures and further application of basic hygiene principles insofar as technologically possible
- K3 Basic measures and systematic application of basic hygiene principles insofar as technologically possible

Notes



EF/EL terminal block system

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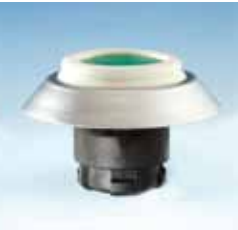


Control devices and indicator lights – N type series

Range with contact and light terminal blocks of the EF/EL system

Structure

A control and indicator device consists of the assemblies “device head with mounting flange” and “contact or light terminal block” (in the case of EMERGENCY STOP devices possibly plus spring element). The type designation of a device head starts with N.



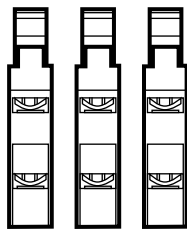
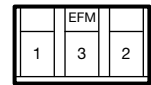
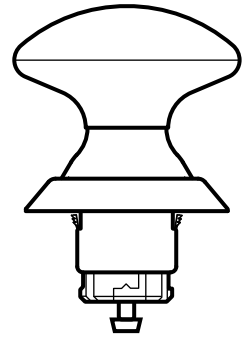
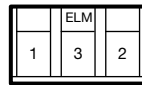
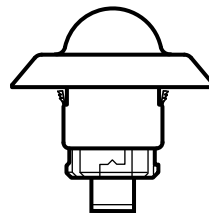
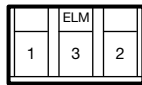
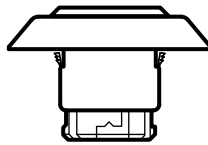
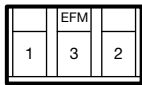
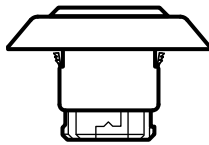
Contact and light terminal blocks

The long-time well tried and tested EF/EL system is used as contact and light terminal block system. This is a modular system consisting of individual elements snapped on to an mounting flange.

Assembly

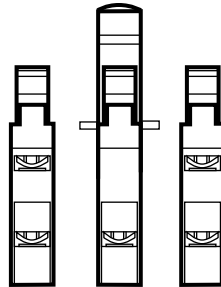
Depending on control device and light indicator up to three blocks can be snapped on to an mounting flange (type EFM for unlit control devices, type ELM for indicator lights and illuminated pushbuttons and illuminated pushbuttons as well as EMERGENCY STOP devices). 1-pole contact blocks are available with an NC and an NO contact.

2-pole contact blocks have one NC/NO contact, two NC or two NO contact combinations. The light terminal blocks ELE... and ELDE.N... as well as the spring element EFR for EMERGENCY STOP devices are intended exclusively for the centre position on the mounting flange.



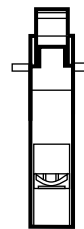
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Contact blocks EF for contact devices of the type series N

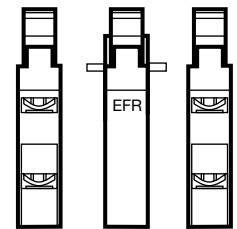


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Light terminal block ELDE with integrated multi-LED for illuminated push-buttons NDL...

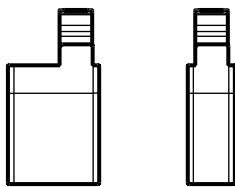


Light terminal blocks ELE... (voltage sensor) with Ba9S holder for indicator light NME... (with integrated multi-LED) or for illuminated pushbuttons NDL... if commercially available LEDs Ba9S (refer to accessories) are to be used

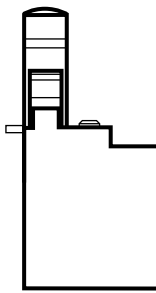


.1 .3 .2

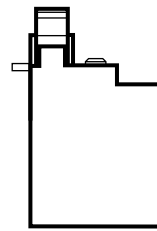
Spring element EFR for EMERGENCY STOP control devices, version 2



Contact and light terminal blocks EL...K or EF...K with WAGO cage clamps (broad shape: 2-pole contact blocks) (narrow shape: 1-pole contact block)



ditto for 48 ... 230 VAC



ditto for 48 ... 230 VAC

Control devices and indicator lights – N type series

Product range structure with contact and light terminal blocks of the EF/EL system: Overview of terminal blocks

Contact blocks



EFK series, 1-/2-pole with WAGO cage clamp terminals, broad shape: 2-pole



EF series, 1-/ 2-pole, either with screw terminals or flat-pin plugs

Light terminal blocks with integrated multi-LED for indicator lights NMLF and illuminated pushbuttons NDL

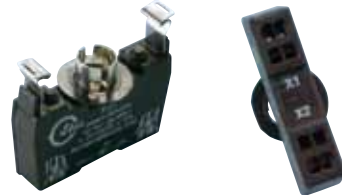


ELDEK.N series with WAGO cage clamp terminals, 24 V versions



ELDE.N/ELDEF.N series, either with screw terminals or flat-pin plugs, 24 V versions

Light terminal blocks (as voltage sensor) with Ba9S holder for indicator lights NMLF and NMLEF and illuminated pushbuttons NDL



ELEK series, 24 V, with WAGO cage clamp terminals



ELE/ELEF series, 24 V, either with screw terminals or flat-pin plugs

Ditto



ELE./ELEF 48 VDC/AC and ELE../ELEF 115 ... 230 VAC, either with screw terminals or flat-pin plugs

Mounting flange with spring element



For EMERGENCY STOP control devices in version 2

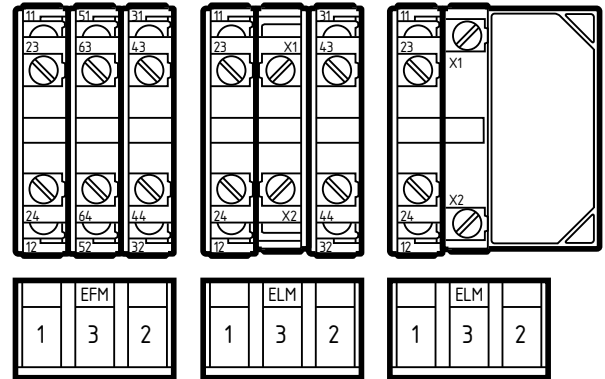
Control devices and indicator lights – N type series

Product range structure with contact and light terminal blocks of the EF/EL system

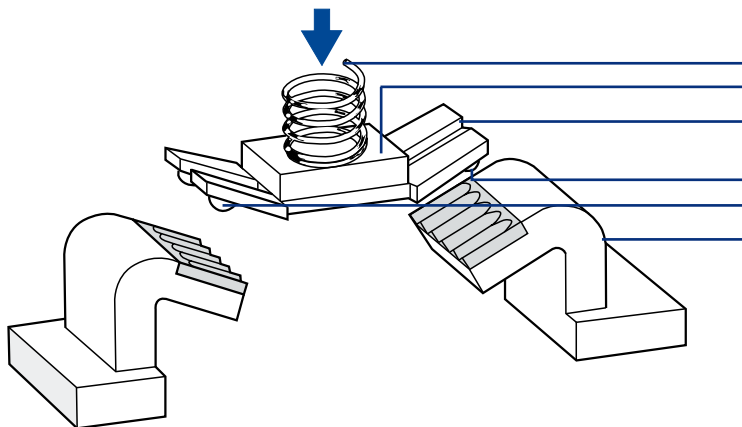
Special design features

All blocks of the EF/EL system have the following special design features:

- A self-cleaning contact bridge system, known as Elan four-way system, which is particularly suitable for very low-voltage and has a lower switching capacity of 5 VDC/3.2 mA (max. 400 VAC/8 A). It is designed in the form of a bent twin contact bridge, with parallel and also diagonal operation.
- A robust block mounting by means of snap-on stainless steel springs.
- Complete terminal designations visible as a glance in compliance with IEC 60 947-1 (VDE 0660, Part 100) with a complete function and sequence number (refer also to product ranges). The function number identifies the NC and NO contact, the sequence number specifies the number and the order of the contacts on the complete switching device. When selecting type we recommend that it be decided at which position the block is to be snapped on to the mounting flange.
- NC contacts with positive opening in compliance with IEC EN 60 947-5-1 (VDE 0660 Part 200).
- Galvanically isolated contact circuits in 2-pole blocks.
- High resistance to shock and vibrations.
- 5 µm hard gold plating for aggressive ambient conditions: on request.



Example of a complete assignment with 2-pole contact and light terminal blocks in the EF/EL system.



The statistical probability of maloperation of the Elan four-way contact system is 0.5 ppm. A variety of special design features (namely the choice of materials and the multi-embossed and angular surface areas of the contacts) provide a high specific contact pressure which, together with a micro-movement, ensures the continuous self-cleaning of the contacts during actuation and reliably eliminates oxide and dirt particles even with the smallest of currents and voltages.

Connection systems

The EF/EL system offers a choice of the following connection systems:

- Screw terminals (1-pole/2-pole blocks)
- Flat-pin plugs (1-pole/2-pole blocks)
- WAGO cage clamp terminals (1-pole/2-pole blocks)

Shock-hazard protection to EN DIN 50274 (VDE 0660 Part 514)

Contact and light terminal blocks with screw terminals and WAGO cage clamp terminals satisfy the shock hazard protection requirements without additional measures in the case of operation of the blocks with dangerous contact voltages.



Warning! Additionally insulated plugs should be used in the case of flat-pin plugs.

Connection system: WAGO cage clamp terminals

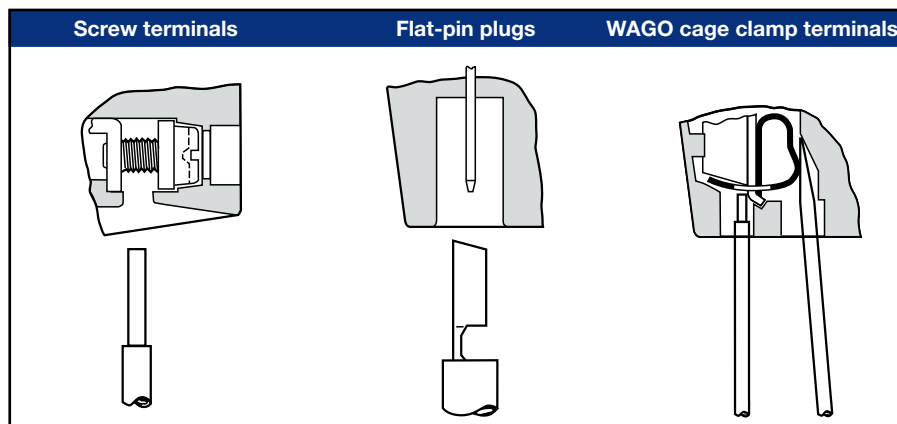
Contact and light terminal blocks with cage clamp terminals do normally not belong to a commercially available range of control and indicating devices. But due to the possibility of saving of wiring time and the fact that WAGO cage clamp terminals are protected from becoming loose even under the effects of strong vibrations, this connection system is also to be found in the type series N.



Warning! In the case of indicator lights and illuminated pushbuttons the positions not occupied on the mounting flanges must be secured using snap-on covers (type EL-15) offered as accessories (refer to page 59) if operated with dangerous contact voltages.



WAGO cage clamp terminal



Two-slotted screws:

Conductor cross-sections $2 \times 0.5 \dots 2.5 \text{ mm}^2$, with wire end ferrule max. 1.5 mm^2 (automatic screwing is possible). The connection screws (recessed head) are sealed on delivery.

Flat-pin plugs

Commercially available flat-pin plugs $6.3 \times 0.8 \text{ mm}$ or $2 \times 2.8 \text{ mm} \times 0.8 \text{ mm}$.

WAGO cage clamp terminals:

Conductor cross-sections $2 \times 0.08 \text{ mm}^2 \dots 1.5 \text{ mm}^2$, splice protection not necessary, but possible.

Control devices and indicator lights – N type series

Product range structure with contact and light terminal blocks of the EF/EL system:

Practical assembly instructions

Installation bore hole

22.3 mm

In accordance with IEC 60947-1, the devices are designed for installation bore holes of 22.3 mm + 0.4 mm. An additional lug cut-out as protection against twisting is not necessary. It is possible to install several devices with a minimum grid of 50 x 50 (maintained selector switch/ spring return selector switch with long knob: 50 x 60 mm).

The device head is inserted soundly and precisely in the bore hole.

Single hand assembly: lugs on the device sleeves serve self-holding purposes so that the mounting flange fitted to the bayonet from the back of the front plate can then be positioned and screwed tight.

Mounting flange fixing

Please remember: you will achieve optimum fixing of the mounting flange if both screws are tightened evenly only as far as the tip of the screw has reached the front plate. This means you will avoid screwing tight as far as possible (recommended torque: max. 0.6 Nm).

Block fixing

It is recommended that the contacts and light terminal blocks are snapped on to the respective position on the mounting flange in accordance with their terminal designations. In order to simplify this assignment the blocks are marked with .1, .2 and .3 (refer to figure on page 12). If only one block is used we recommend that this be fixed to position 3.

The light terminal blocks ELE... and ELDE..N... are intended exclusively for the centre position of the mounting flange (no. 3). They must be snapped on first before any other EF contact blocks. When dismantling the EF blocks are to be removed first.



Warning! For reasons of hygiene and sealing it is not possible to replace a bulb in both ranges). If the multi-LEDs used in the indicator lights and illuminated push-buttons become defective or reach the end of their serviceable life the entire device head or the light terminal block should be replaced.



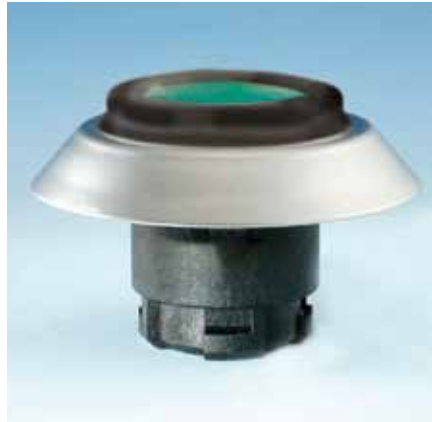
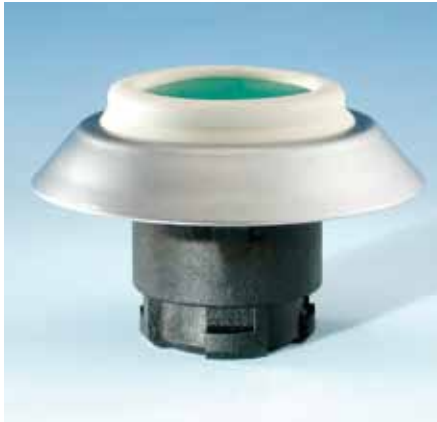
Warning! Damaged device heads, in particular devices with damaged seals, must be replaced immediately since otherwise reliable hygiene protection is no longer guaranteed.



Notes



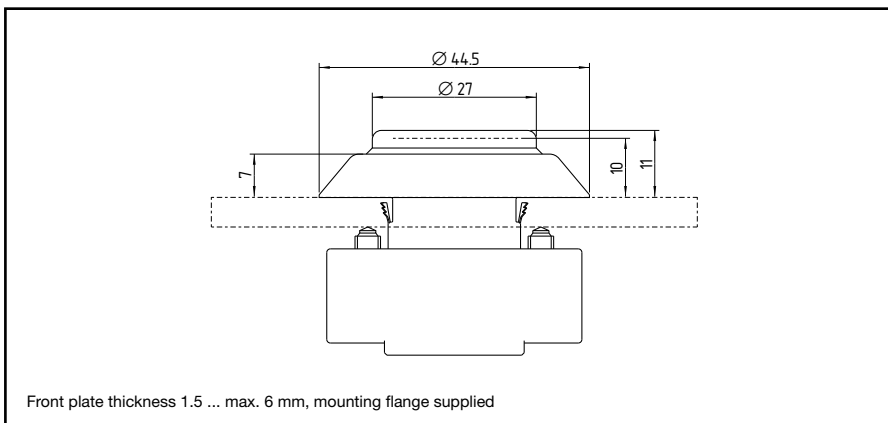
Pushbuttons



Left: type series N with sealing bellows, color white (standard).

Right: type series N with sealing bellows, color black.

- Protective collar against unintentional actuation: refer to page 58



Available models					
Devices	Color	White sealing bellows		Black sealing bellows	
		Part Number	Ident. Nr.	Part Number	Ident. Nr.
Type series N	black	NDT SW	080 0010	NDT GR/SW	080 0012
	yellow	NDT GB	080 0015	NDT GR/GB	080 0017
	red	NDT RT	080 0020	NDT GR/RT	080 0022
	green	NDT GN	080 0025	NDT GR/GN	080 0027
	white	NDT WS	080 0030	NDT GR/WS	080 0032
	blue	NDT BL	080 0035	NDT GR/BL	080 0037
	gray	NDT GR	080 0040	NDT GR/GR	080 0042
	Contact blocks: refer to page 30				

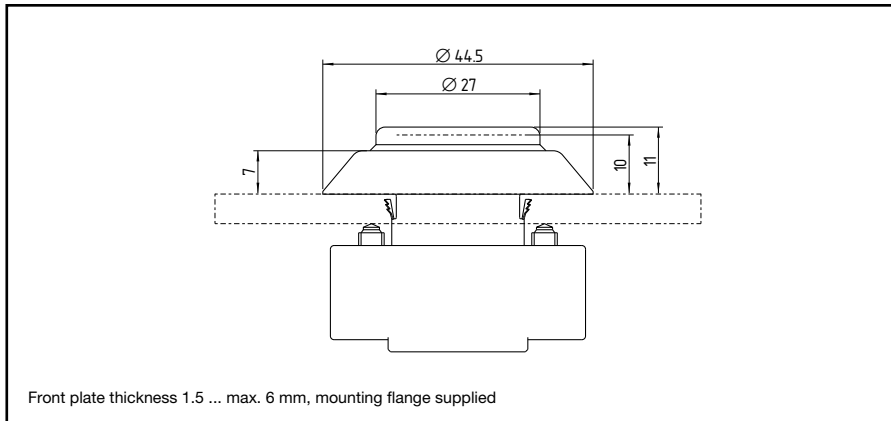
Illuminated pushbuttons



Left: type series N with sealing bellows, color white (standard).

Right: type series N with sealing bellows, color black.

- For light terminal blocks ELDE... (with integrated “super bright” multi-LED)
- For light terminal blocks ELE... (voltage supply with Ba9S socket for commercially available LEDs, refer to accessories on page 59)
- Protective collar against unintentional actuation: refer to page 58



Light terminal blocks with integrated multi-LED for indicator lights NMLF and illuminated pushbuttons NDL



Light terminal blocks (as voltage sensor) with Ba9S holder for indicator lights NMLF and NMLEF and illuminated pushbuttons NDL



Order Details

For integrated LED version

1. Select device head (i.e., NDL GB)
2. Select integrated multi-LED terminal block (i.e., ELDE.N GB)
3. Select contact block(s)

For Ba9S socket version

1. Select device head (i.e., NDL GB)
2. Select voltage block ELE and LED bulb LE24/9 or select voltage block EL and supply own Ba9S incandescent bulb
3. Select contact block(s)

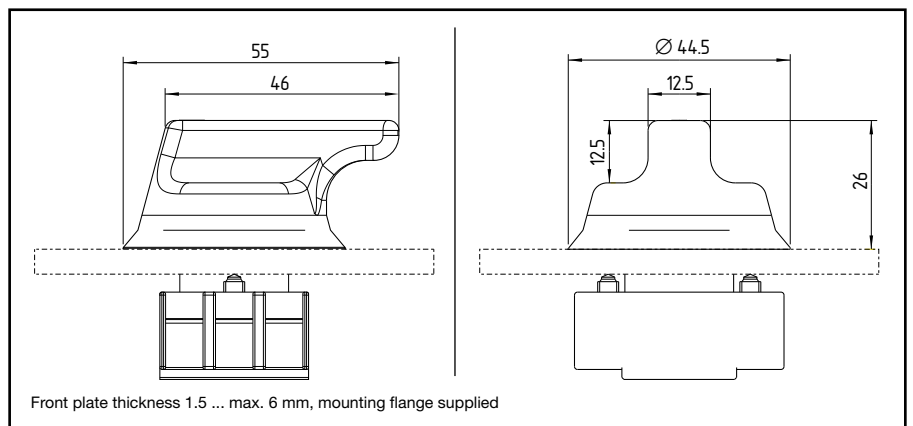
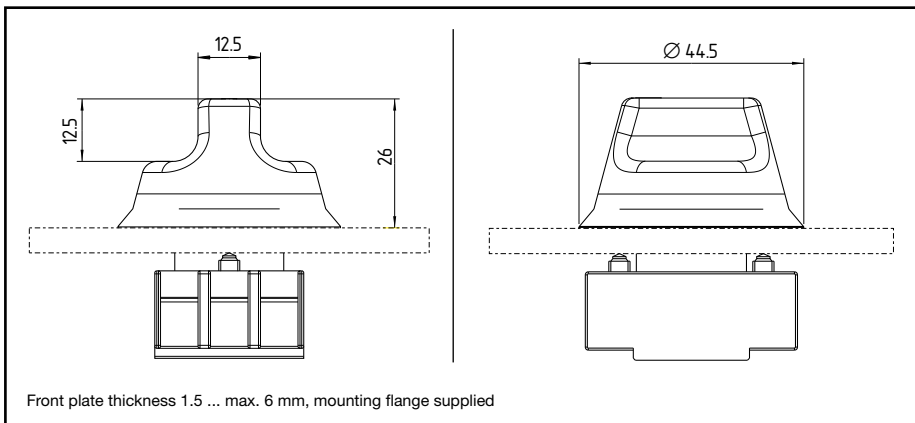
Product range					
Devices	Color	White sealing bellows		Black sealing bellows	
		Part Number	Ident. Nr.	Part Number	Ident. Nr.
Type series N	yellow	NDL GB	080 5015	NDL GR/GB	080 5017
	red	NDL RT	080 5020	NDL GR/RT	080 5022
	green	NDL GN	080 5025	NDL GR/GN	080 5027
	white	NDL WS	080 5030	NDL GR/WS	080 5032
	blue	NDL BL	080 5035	NDL GR/BL	080 5037

Contact and light terminal blocks: refer to page 30 et seq.

Maintained selector switches, spring return selector switches with short or long knob



- .1 version with 46 mm long knob: see below and product range table
- Maintained selector switch inhibit refer to page 22



Product range						
	Devices	Switching angle	Knob color	Sealing ring color	Part Number ¹	Ident. Nr.
Type series N	Spring return switch, 2 positions	1 × 55°	black	black	NWT 21 NWT 21.1	0802000 0802010
			white	white	NWT 21 WS NWT 21.1 WS	0802003 0802013
	Spring return selector switch, 3 positions	2 × 35°	black	black	NWT 32 NWT 32.1	0802020 0802030
			white	white	NWT 32 WS NWT 32.1 WS	0802023 0802033
	Selector switch, 3 positions right – spring return (touch position)	right 35°	black	black	NWTS 32 NWTS 32.1	0802035 0802040
			white	white	NWTS 32 WS NWTS 32.1 WS	0802038 0802043
	left – maintained (latched position)	left 55°	black	black	NWTS 321 NWTS 321.1	0802045 0802050
			white	white	NWTS 321 WS NWTS 321.1 WS	0802048 0802053
	Selector switch, 3 positions right – maintained (latched position)	right 55°	black	black	NWTS 321 NWTS 321.1	0802045 0802050
			white	white	NWTS 321 WS NWTS 321.1 WS	0802048 0802053
	left – spring return (touch position)	left 35°	black	black	NWTS 321 NWTS 321.1	0802045 0802050
			white	white	NWTS 321 WS NWTS 321.1 WS	0802048 0802053
	Maintained selector switch, 2 positions	1 × 70°	black	black	NWS 21 NWS 21.1	0802060 0802070
			white	white	NWS 21 WS NWS 21.1 WS	0802063 0802073
	Maintained selector switch, 3 positions	2 × 55°	black	black	NWS 32 NWS 32.1	0802080 0802090
			white	white	NWS 32 WS NWS 32.1 WS	0802083 0802093

For contact blocks refer to page 30

¹ .1 version: long knob (46 mm), maintained selector switches with long knobs require a grid of 50 x 60 mm.

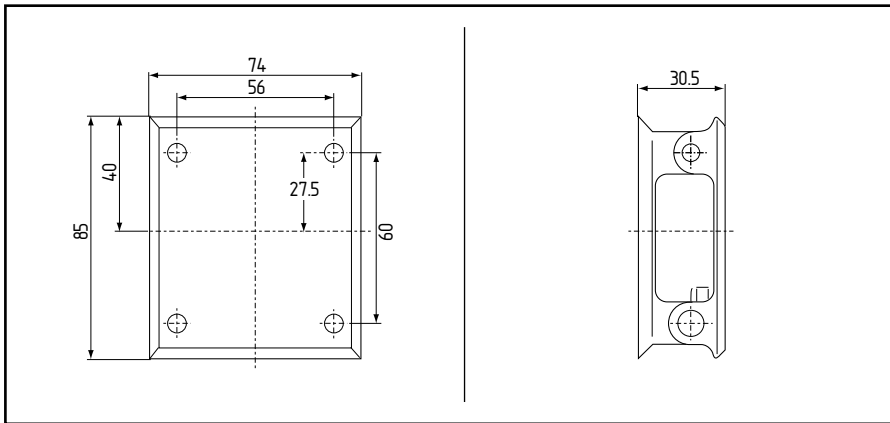
Maintained selector switch inhibit



Only for maintained selector switches with long knob

- Alternative to key-operated maintained selector switch
- Padlocks not supplied

- VA version: on request (but not entirely suitable for food processing machines because the minimum radiuses required for a hygienic-conformance design cannot be met for technical reasons)
- Maintained selector switch inhibit for main switch: on request



Assembly instructions

- Mounted from the back. For this purpose there are 4 bore holes of 3.5 mm diameter, 12 mm deep for self-cutting screws. The grid measurement in 60 x 56 mm.

Product range				
	Devices	Color	Part Number	Ident. Nr.
Type series N	Maintained selector switch inhibit for 2 position versions	transparent/gray	NWSP 21 GR	080 3000
	Maintained selector switch inhibit for 3 position versions	transparent/gray	NWSP 32 GR	080 3020

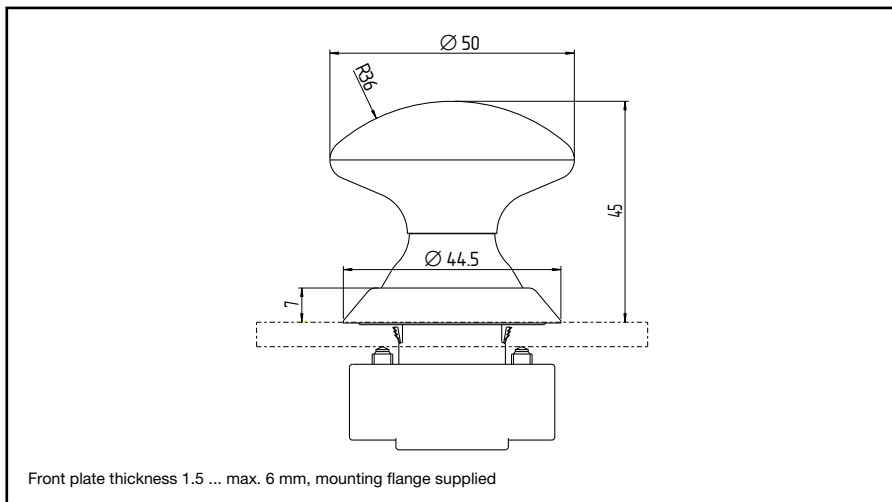
Maintained selector switches: refer to page 20

Mushroom buttons



Left: type series N with sealing bellows, color white (standard).

Right: type series N with sealing bellows, color black.



Product range					
Devices	Color	White sealing bellows		Black sealing bellows	
		Part Number	Ident. Nr.	Part Number	Ident. Nr.
Type series N	black	NDP 50 SW	080 0710	NDP 50 GR/SW	080 0712
	yellow	NDP 50 GB	080 0715	NDP 50 GR/GB	080 0717
	green	NDP 50 GN	080 0725	NDP 50 GR/GN	080 0727
	white	NDP 50 WS	080 0730	NDP 50 GR/WS	080 0732
	blue	NDP 50 BL	080 0735	NDP 50 GR/BL	080 0737

For contact blocks refer to page 30

The EMERGENCY STOP control devices comply with the safety requirements to IEC EN 60 947-5-5 (VDE 0660 Part 210) (1) and EN 418 (2) and in future ISO EN DIN 13 850* (3).

After reaching a pressure point the device head automatically moves under spring force to the off position. An actuated device is reset by pulling the device head.

There are two versions:

- Version (1): EMERGENCY STOP control devices with snap-action behavior mechanism in the actuator head
- Version (2): ditto with snap-action behaviour, but operated by a separate spring element, type EFR (refer also to “Version (2): Special features/ advantages”).

The two versions differ in their minimum actuation force:

(1) = approx. 60 N

(2) = approx. 40 N

and in the force of reset by pulling the device head:

(1) = approx. 10 N

(2) = approx. 27 N.

Refer to page 26 for additional technical details.



EMERGENCY STOP devices must be replaced immediately if a correct snap-action operation is not longer guaranteed due to the limited mechanical life ($\geq 100,000$ switching cycles). The safety-related positive opening of the device will not be affected.

- Yellow EMERGENCY STOP labels: Refer to accessories on page 57 (enlarged grid dimension 70 x 70 mm)

* ISO EN 13 850 is soon to supersede EN 418. New test requirements for the devices are already set out today in IEC EN 60 947-5-5 (VDE 0660 Part 210).

IEC EN 60204-1 makes a distinction between the following:

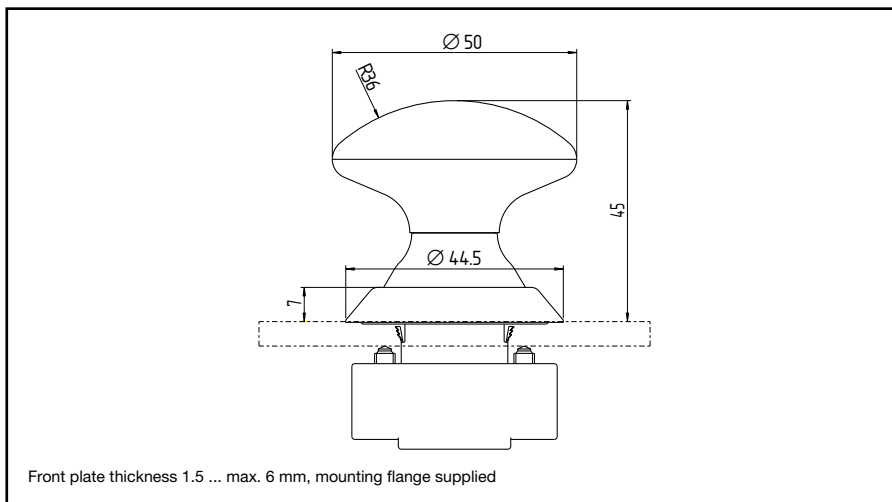
- Bringing to a standstill in an emergency (EMERGENCY STOP): an action in an emergency intended to halt a process or a movement which would be hazardous.
- Shut-down in an emergency (EMERGENCY OFF): an action in an emergency intended to switch off the supply of electrical power entirely or partly to an installation if there is a risk of electrical shock or another risk of electrical origin.

- (1) IEC EN 60947-5-5 (VDE 0660 Part 210): Low-voltage switchgear – Part 5-5: control devices and switching elements – electrical EMERGENCY STOP device with mechanical locking
- (2) EN 418: Safety of machines – EMERGENCY STOP device, functional aspects, design principles
- (3) ISO EN 13850*: Safety of machines – EMERGENCY STOP – design principles



Left: type series N with sealing bellows, color white (standard).

Right: type series N with sealing bellows, color black.



Order Details

1. Select device head
2. Select contact block(s) (EF220¹ or EF303)

Product range version (1)						
	Device	Color	White sealing bellows		Black sealing bellows	
			Part Number	Ident. Nr.	Part Number	Ident. Nr.
Type series N	EMERGENCY STOP slam button	red	NDRZ 50 RT ²	0801280	NDRZ 50 GR/RT ²	0801281

For contact blocks refer to page 30

¹ Max 1-EF220 can be used

² Only in connection with NC contacts of the contact blocks EF 220..., EF 303... and EFK 30...

EMERGENCY STOP control devices (continued)

Product range version (2)

	Device	Color	White sealing bellows		Gray sealing bellows	
			Part Number	Ident. Nr.	Part Number	Ident. Nr.
Type series N	EMERGENCY STOP slam button	red	NDRR 50 RT ¹	080 1270	NDRR 50 GR/RT ¹	080 1272
	Spring element ²		EFR	0280187	EFR	0280187

For contact blocks refer to page 30.

¹ Only in connection with NC contacts of the contact blocks EF 220..., EF 303... and EFK 30...

² Installation depth as for EF/EL blocks + 5 mm (refer to pages 32 and 35).

Special features/ advantages

In version 2 the snap action of the EMERGENCY STOP control devices is realised with a separate spring element (type EFR). For this purpose the spring element EFR is snapped on to the centre position of the mounting flange EFM. After first actuation the plunger in the EMERGENCY STOP device head positively engages with the spring element.

An additional precautionary measure (as an option) in version 2 is a so-called safety plate (see photo) which fixes the snapped-on contact blocks a second time. The safety plate corrects any incorrect fixing due to the contact blocks not being snapped completely on to the mounting flange, and under extreme conditions of use also serves as a second fixing of the device head, mounting flange and contact block(s).

Protection from circumvention

Machine manipulation (= manipulative opening of the NC contact without the device head moving to the OFF position) is nearly ruled out in the version (2).



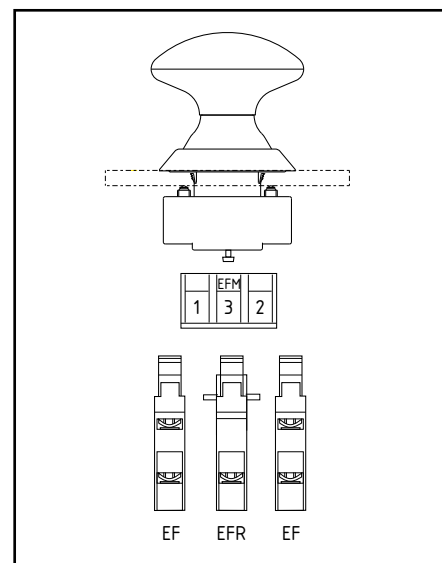
Spring element EFR with mounting flange



Safety plate (supplied)

Order Details

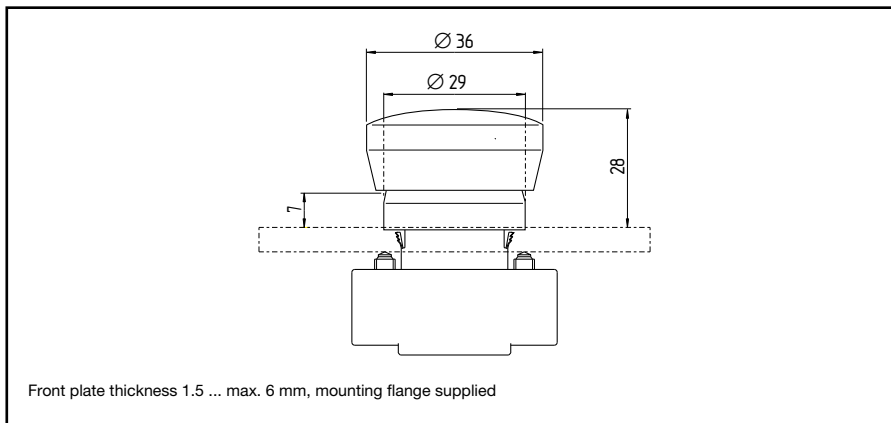
1. Select device head
2. Add spring element EFR
3. Select contact block(s) (EF220 or EF303)



EMERGENCY STOP control devices (continued)



- In addition to N-series EMERGENCY STOP control devices there are EMERGENCY STOP versions KDRKZ... and KDRRKZ...
- These devices are not suitable for hygienic-conform applications.
- Please note functional differentiation between version (1) and version (2) as described on page 24 also here.
- IP65 rated enclosure.



Product range version (1)

	Device	Color	Black sealing bellows	
			Part Number	Ident. Nr.
Type series K for heavy-duty applications and similar	EMERGENCY STOP slam button	red	KDRKZ 40 RT ¹	029 1287

Product range version (2)

Type series K for heavy-duty applications and similar	EMERGENCY STOP slam button	red	KDRRKZ 40 RT ¹	029 7520
	Spring element ²		EFR	028 0187

For contact blocks refer to page 30

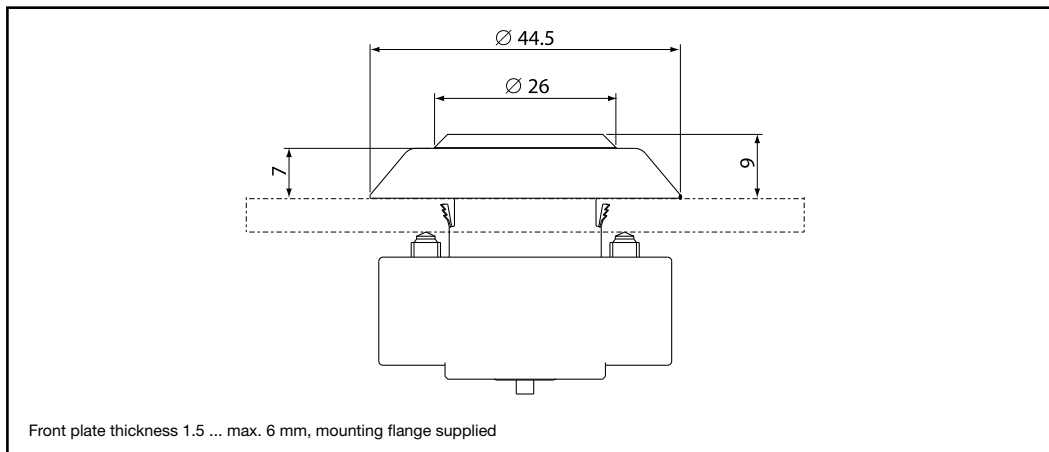
¹ Only in connection with NC contacts of the contact blocks EF 220..., EF 303... and EFK 30...

² Installation depth as for EF/EL blocks + 5 mm (refer to pages 32 and 35).

Indicator light with flat cap



- Version NMEF: with integrated “super-bright” multi-LEDs in device head (illuminated over entire surface) for light terminal blocks ELE ... as voltage supply
- Version NML: device head without bulb. For light terminal blocks ELE... as voltage supply. In this case the Ba9S holder accommodates LE24/9 (refer to accessories on page 59).
- Symbol printing: on request



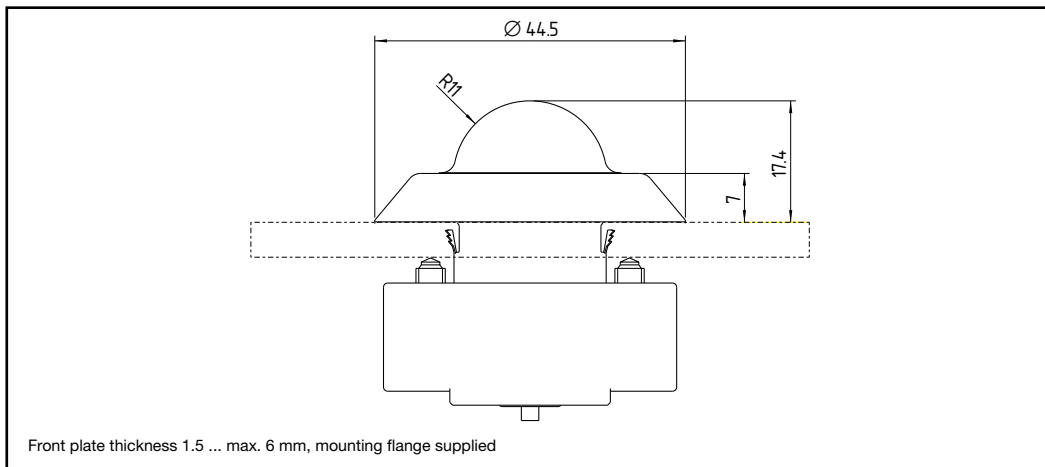
Product range				
Devices		Color	Part Number	Ident. Nr.
With integrated “superbright” multi-LEDs in the device head Order Details 1. Select device head 2. Add voltage block ELE	Indicator light with flat cap	yellow	NMEF GB	080 7088
		red	NMEF RT	080 7079
		green	NMEF GN	080 7086
		white	NMEF WS	080 7080
		blue	NMEF BL	080 7082
For LEDs and bulbs with Ba9S holder Order Details 1. Select device head 2. Add voltage block ELE 3. Add LED bulb LE24/9 or for incandescent Ba9S bulbs use voltage block EL	Indicator light with flat cap	yellow	NML GB	080 7215
		red	NML RT	080 7220
		green	NML GN	080 7225
		white	NML WS	080 7230
		blue	NML BL	080 7235

Refer to page 31 for light terminal blocks

Indicator light with domed cap



- Version NME: with integrated “superbright” multi-LEDs in device head (illuminated over entire surface) for light terminal blocks ELE... as voltage supply
- Version NMLH: device head without bulb. For light terminal blocks ELE... as voltage supply. In this case the Ba9S holder accommodates LE24/9 (refer to accessories on page 59).
- Symbol printing: on request



Product range

Devices		Color	Part Number	Ident. Nr.
With integrated “superbright” multi-LEDs in the device head Indicator light with domed cap Order Details 1. Select device head 2. Add voltage block ELE		yellow	NME GB	080 7040
		red	NME RT	080 7036
		green	NME GN	080 7038
		white	NME WS	080 7045
		blue	NME BL	080 7050
For LEDs and bulbs with Ba9S holder Indicator light with domed cap Order Details 1. Select device head 2. Add voltage block ELE 3. Add LED bulb LE24/9 or for incandescent Ba9S bulbs use voltage block EL		yellow	NMLH GB	080 7315
		red	NMLH RT	080 7320
		green	NMLH GN	080 7325
		white	NMLH WS	080 7330
		blue	NMLH BL	080 7335

Refer to page 31 for light terminal blocks

Contact and light terminal block system EF/EL with screw terminals or flat-pin plugs



2-pole contact blocks					
Function/contact travel diagram (mm)	Mounting flange position	with screw terminal		with flat-pin plug	
		Part Number	Ident. Nr.	Part Number	Ident. Nr.
1 NC ¹ 0 2 4 6 mm 	Pos. 1	EF10.1	028 0010	EF10F.1	028 1010
	Pos. 2	EF10.2	028 0020	EF10F.2	028 1020
	Pos. 3	EF10.3	028 0030	EF10F.3	028 1030
1 NO 0 2 4 6 mm 	Pos. 1	EF03.1	028 0040	EF03F.1	028 1040
	Pos. 2	EF03.2	028 0050	EF03F.2	028 1050
	Pos. 3	EF03.3	028 0060	EF03F.3	028 1060
2 NC ¹ 0 2 4 6 mm 	Pos. 1	EF110.1	028 0070	EF110F.1	028 1070
	Pos. 2	EF110.2	028 0080	EF110F.2	028 1080
	Pos. 3	EF110.3	028 0090	EF110F.3	028 1090
2 NC 0 2 4 6 mm 	Pos. 1	EF220.1	028 1382	EF220F.1	028 1388
	Pos. 2	EF220.2	028 1384	EF220F.2	028 1390
	Pos. 3	EF220.3	028 1386	EF220F.3	028 1394
2 NO 0 2 4 6 mm 	Pos. 1	EF033.1	028 0100	EF033F.1	028 1100
	Pos. 2	EF033.2	028 0110	EF033F.2	028 1110
	Pos. 3	EF033.3	028 0120	EF033F.3	028 1190
1 NC/1 NO ¹ 0 2 4 6 mm 	Pos. 1	EF103.1	028 0130	EF103F.1	028 1130
	Pos. 2	EF103.2	028 0140	EF103F.2	028 1140
	Pos. 3	EF103.3	028 0150	EF103F.3	028 1150
1 NC/1 NO overlapping ¹ 0 2 4 6 mm 	Pos. 1	EF301.1	028 0160	EF301F.1	028 1160
	Pos. 2	EF301.2	028 0170	EF301F.2	028 1170
	Pos. 3	EF301.3	028 0180	EF301F.3	028 1180
1 NC/1 NO simultaneously switching ² 0 2 4 6 mm 	Pos. 1	EF303.1	028 1360	EF303F.1	028 1375
	Pos. 2	EF303.2	028 1365	EF303F.2	028 1380
	Pos. 3	EF303.3	028 1370	EF303F.3	028 1381
1 NC/1 NO with safety spring, simultaneously switching ^{2,3} 0 2 4 6 mm 	Pos. 1	EF303.S.1	028 1300	EF303SF.1	028 1330
	Pos. 2	EF303.S.2	028 1310	EF303SF.2	028 1340
	Pos. 3	EF303.S.3	028 1320	EF303SF.3	028 1350

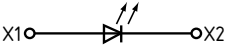


¹ not suitable for EMERGENCY STOP devices NDRR50/NDRZ50


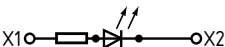

² not suitable for maintained selector switches NWS/NWT

³ The reset spring of this block is designed as safety spring, i.e. due to the special guide and coiling of the spring the perfect function of the device or contact block is guaranteed also in the case of a spring breaking. We recommend that contact blocks with safety spring be used particularly when special reliability demands are placed on the NO function. NC and NO contacts operate practically simultaneously in this block version, but without overlapping.

N.B.: The terminal designation for the contacts to IEC 60 947-1 contains a complete function and classification number. The function number identifies the NC or NO contact, the classification number specifies the number and series of the contacts in the complete switching device. In this respect we recommend that it be determined in the form designation to which position of the mounting flange the contact block is to be attached.

Refer to page 32 for terminal designations.

Light terminal blocks with integrated multi-LED for illuminated pushbuttons NDL					
Diagram/ operating voltage	Color	with screw terminal		with flat-pin plug	
		Part Number	Ident. Nr.	Part Number	Ident. Nr.
 24 VDC/AC	red	ELDE.N RT 24	027 6610	ELDEFN RT 24	027 6630
	yellow	ELDE.N GB 24	027 6611	ELDEFN GB 24	027 6631
	green	ELDE.N GN 24	027 6612	ELDEFN GN 24	027 6632
	blue	ELDE.N BL 24	027 6613	ELDEFN BL 24	027 6633
	white	ELDE.N WS 24	027 6614	ELDEFN WS 24	027 6634
 48 VDC/AC	red	ELDE.N RT 48	027 6615	ELDEFN RT 48	027 6635
	yellow	ELDE.N GB 48	027 6616	ELDEFN GB 48	027 6636
	green	ELDE.N GN 48	027 6617	ELDEFN GN 48	027 6637
	blue	ELDE.N BL 48	027 6618	ELDEFN BL 48	027 6638
	white	ELDE.N WS 48	027 6619	ELDEFN WS 48	027 6639
 115 ... 230 VAC	red	ELDE.N RT 230	027 6625	ELDEFN RT 230	027 6645
	yellow	ELDE.N GB 230	027 6626	ELDEFN GB 230	027 6646
	green	ELDE.N GN 230	027 6627	ELDEFN GN 230	027 6647
	blue	ELDE.N BL 230	027 6628	ELDEFN BL 230	027 6648
	white	ELDE.N WS 230	027 6629	ELDEFN WS 230	027 6649

Light terminal blocks (voltage supply) with Ba9S holder for illuminated pushbuttons NME/NMEF ² and NML/NMLH ¹				
Diagram/ operating voltage	with screw terminal		with flat-pin plug	
	Part Number	Ident. Nr.	Part Number	Ident. Nr.
 24 VDC/AC	ELE	027 7090	ELEF	027 7093
 48 VDC/AC	ELE 48	027 7095	ELEF 48	027 7089
 115 ... 230 VAC	ELE 230	027 7100	ELEF 230	027 7102

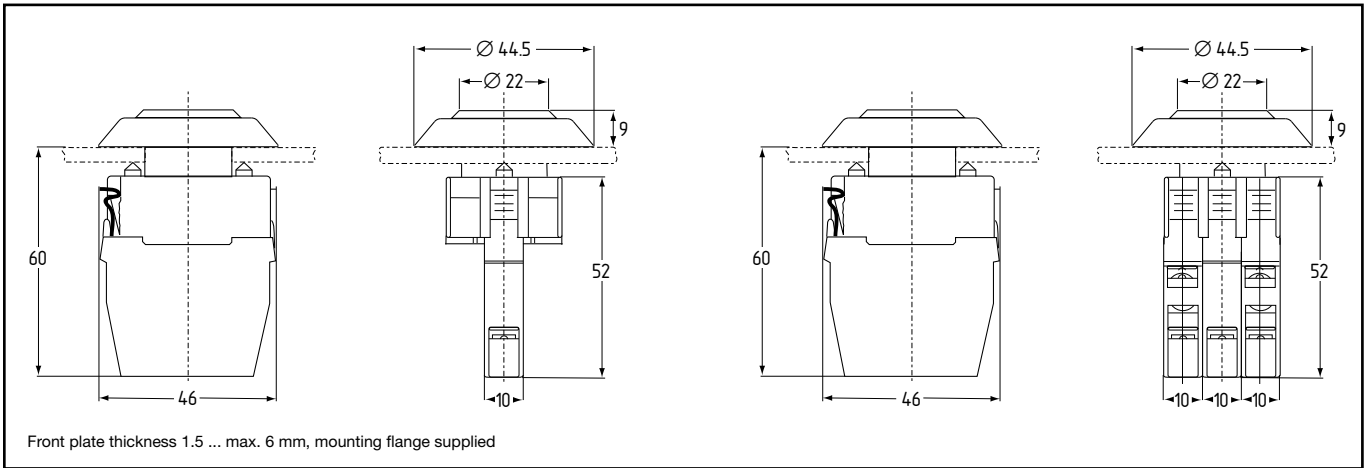
¹ The maximum length of socket-based LEDs or bulbs is 27 mm.

² LED integrated into the indicator light NME/NMEF

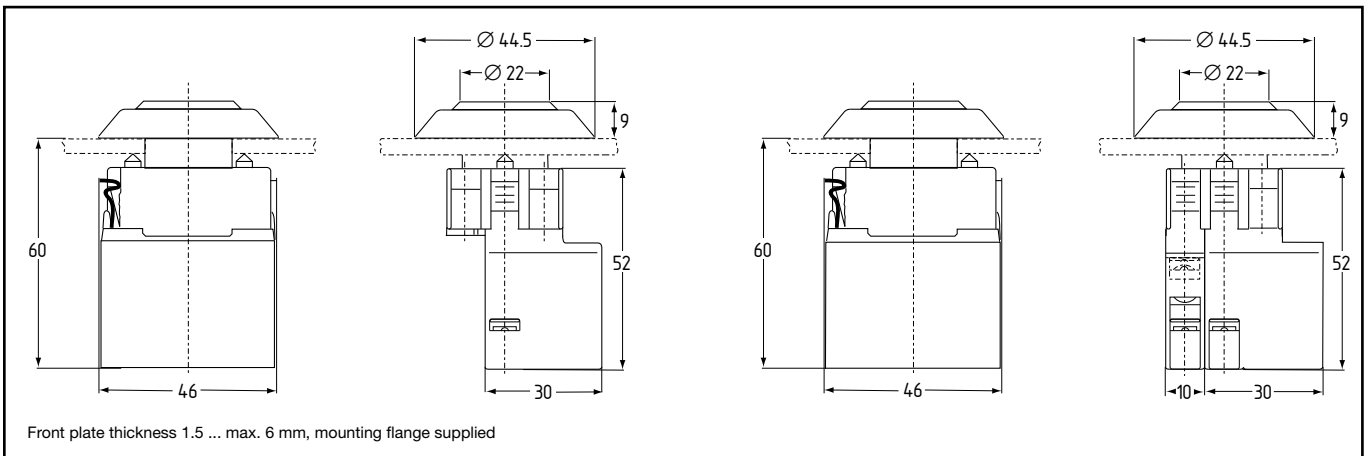


Contact and light terminal block system EF/EL with screw terminals or flat-pin plugs (continued)

Dimensions of contact and light terminal blocks EF/ELDE.N/ELE



Dimensions of light terminal blocks with series resistance ELDE.N 48 VAC/DC, 115 ... 230 VAC/ELE 48 VAC/DC, 115 ... 230 VAC



Terminal designations				
Type	Function	Pos. 1	Pos. 2	Pos. 3
with screw terminal/ with flat-pin plug/ with WAGO cage clamp terminals	1 NC	11-12	21-22	31-32
	1 NO	13-14	23-24	33-34
	2 NC	11-12/21-22	31-32/41-42	51-52/61-62 ¹
	2 NO	13-14/23-24	33-34/43-44	53-54/63-64 ¹
	1 NC/1 NO	11-12/23-24	31-32/43-44	51-52/63-64 ¹

¹ not applicable to blocks with WAGO cage clamp terminals

Contact and light terminal block system EF/EL with WAGO cage clamp terminals*



1-pole contact blocks			
Function/ contact travel diagram (mm)	Mounting flange position	Part Number	Ident. Nr.
1 NC ¹ 0 2 4 6 mm ■ □ □ □ □	Pos. 1	EFK10.1	028 1001
	Pos. 2	EFK10.2	028 1002
	Pos. 3	EFK10.3	028 1003
1 NC 0 2 4 6 mm ■ ■ □ □ □	Pos. 1	EFK30.1	028 1005
	Pos. 2	EFK30.2	028 1006
	Pos. 3	EFK30.3	028 1007
1 NO 0 2 4 6 mm □ □ ■ ■ □	Pos. 1	EFK03.1	028 1066
	Pos. 2	EFK03.2	028 1067
	Pos. 3	EFK03.3	028 1068

¹ not suitable for EMERGENCY STOP devices NDRR/NDRZ50...



2-pole contact blocks			
Function/ contact travel diagram (mm)	Mounting flange position	Part Number	Ident. Nr.
2 NC 0 2 4 6 mm ■ ■ □ □ □	Pos. 1	EFK330.1	028 1008
	Pos. 2	EFK330.2	028 1009
2 NO 0 2 4 6 mm □ □ ■ ■ □	Pos. 1	EFK033.1	028 0996
	Pos. 2	EFK033.2	028 0997
1 NC/1 NO ¹ 0 2 4 6 mm ■ □ □ ■ □	Pos. 1	EFK103.1	028 1000
	Pos. 2	EFK103.2	028 1004

¹ not suitable for EMERGENCY STOP devices NDRR/NDRZ50...

N.B.: The terminal designation for the contacts to IEC 60 947-1 contains a complete function and classification number. The function number identifies the NC or NO contact, the classification number specifies the number and series of the contacts in the complete switching device. In this respect we recommend that it be determined in the form designation to which position of the mounting flange the contact block is to be attached.

Refer to page 32 for terminal designations

*** Above contact blocks with WAGO cage clamps available on special factory order only.**

Contact and light terminal block system EF/EL with WAGO cage clamp terminals* (continued)



Light terminal blocks with integrated multi-LED for indicator lights NDL/EDL... O and indicator lights NML/NMLH

Diagram	Color	Part Number	Ident. Nr.
<p>24 VDC/AC</p>	red	ELDEK RT	027 6650
	yellow	ELDEK GB	027 6651
	green	ELDEK GN	027 6652
	blue	ELDEK BL	027 6653
	white	ELDEK WS	027 6644



Light terminal blocks (voltage supply) with Ba9S holder for indicator light NME/NMEF¹ and NML/NMLH²

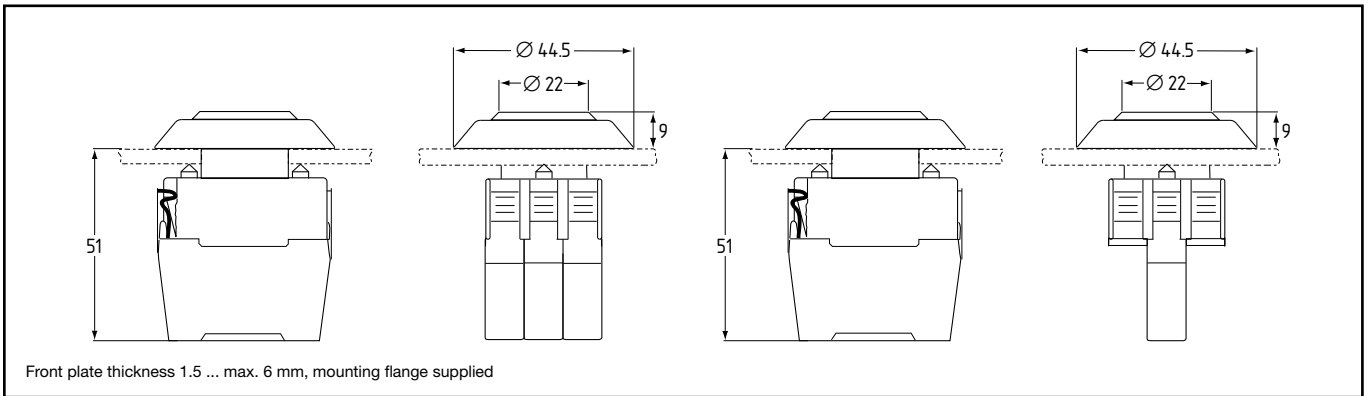
Diagram	Part Number	Ident. Nr.
<p>24 VDC/AC</p>	ELEK	027 7096

¹ or for light terminal block NDL if socket-based LEDs or bulbs are to be used (maximum length 27 mm). Refer also to accessories on page 59.

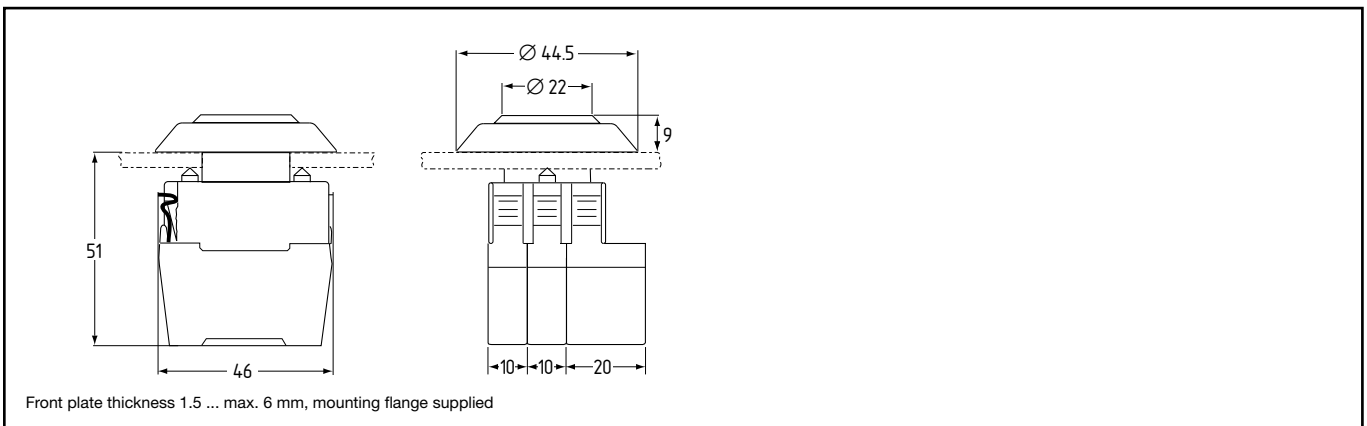
² LED integrated into the indicator light NME/NMEF

*** Above contact blocks with WAGO cage clamps available on special factory order only.**

Dimensions of 1-pole contact and light terminal blocks



Dimensions of 2-pole contact and light terminal blocks¹



¹ max. 1 x 2-pole block recommended

Control devices and indicator lights

Type series	N
Regulations (if applicable)	IEC EN 60947-1 (DIN VDE 0660 Part 100), IEC EN 60947-5-1 (VDE 0660 Part 200)
CE conformity	to Directive 89/336/EEC
Installation diameter	D 22 (22.3 mm + 0.4 mm)
Front plate thickness	1.5 ... max. 6 mm
Grid dimensions	50 × 50 mm, 50 × 60 mm for maintained selector switches/spring return selector switches with 46 mm long knob; please observe other exceptions
Type of fixing	mounting flange
Max. torque for fixing screws	approx. 0.6 Nm
Temperature range	– –25 °C ... +80 °C – maintained selector switch/spring return selector switch: 0 °C ... +80 °C – max. ambient temperature for illuminated pushbuttons/indicator lights – max. +80 °C with LEDs from Elan – max. +40 °C with other bulbs (outside makes)
Type of protection	IP 67 to EN DIN 60 529, IP 69K to DIN 40 050 Part 9 (resistant to high pressure water jet)
Type of sealing	diaphragms, lip seals, shaped seals
Full insulation	yes
Materials	PA GV, ABS, NBR, PA; plastics: glass-fibre reinforced, self-extinguishing
Bezel version	ABS galvanically matt chromed
Actuating lift	5 mm



Warning! For reasons of hygiene and sealing it is not possible to change LEDs/bulbs. If the multi-LEDs become defective in the indicator lights and illuminated pushbuttons or if they have reached the end of their serviceable life, the complete device head or the light terminal block must be replaced.

Warning! Damaged device heads, particularly devices with damaged seals, must be replaced immediately since otherwise reliable hygiene protection is not guaranteed.

EMERGENCY STOP devices

Type series	N
Regulations	EN 418, ISO EN 13850, IEC EN 60947-5-5 (VDE 0660 Part 210)
CE conformity	to Directive 89/336/EC and 98/37/EC
Mechanical serviceable life of the snap-action function	≥ 100,000 switching cycles ¹
Shock resistance	30 g/18 ms
Other data	see above

¹ The end of the mechanical life of the snap-action function has no influence on the safety function of the positive opening. Nevertheless the device must be replaced immediately.

Contact blocks EF

Regulations (if applicable)	IEC EN 60947-1 (DIN VDE 0660 Part 100), IEC EN 60947-5-1 (VDE 0660 Part 200),
CE conformity	to Directive 89/336/EEC
Rated operating voltage U_g max.	400 V




Contact blocks EF (continued)

Rated insulation voltage U_i	440 V, test voltage to EN 60947-1 Table 12 A: 1,890 V
Rated operating current I_o as dependent on the utilization category and test voltage	8 A, AC-15, 250 VAC 5 A, DC-13, 24 VDC
Thermal rated current I_{th} (in air)	10 A
Short-circuit protection	gG 10 A slow-blowing
Air clearance and creepage to EN DIN 60664-1	4 kV/3
Galvanic isolation of the contact bridges	yes
Proof of positive opening	2.5 kV surge voltage
Positive opening path	approx. 2 mm after reaching opening point
Switching of small loads	≥ 5 V, 3.2 mA
Switching frequency	1,200 s/h
Climatic resistance to IEC EN 60068	Part 2-20
Installed position	random
Mechanical life to IEC EN 60947-5-1 (VDE 0660 Part 200)	10×10^6 switching cycles
Shock resistance	110 g/4 ms – 30 g/18 ms, no chatter (accordingly smaller in the case of operating heads with larger density)
Vibration resistance	>20 g/10 ... 200 Hz (accordingly smaller in the case of operating heads with larger density)
Chatter time (100 mm/s)	<5 ms
Housing material	PA GV; plastics: glass-fibre reinforced, self-extinguishing
Terminal designations	to IEC 60947-1 (VDE 0660 Part 100)
Type of protection	IP 40
Contact points, terminal points	Fine silver, feather bronze or Ms carrier
Actuating force at – 2 mm lift – 4 mm lift – 6 mm lift	4 N 7 N 9 N
Shock hazard protection	refer to page 55

Light terminal blocks and voltage supplies

Regulations (if applicable)	IEC EN 60947-1 (DIN VDE 0660 Part 100), IEC EN 60947-5-1 (VDE 0660 Part 200)
CE conformity	to Directive 89/336/EWG
Rated operating voltage U_e max.	250 V
Rated insulation voltage U_i	440 V, test voltage 2,500 V
Terminal designations	X1/X2 to IEC 60947-1 (DIN VDE 0660 Part 100)
Terminals	non-interchangeable
Other data	refer to EF

Approvals

  (listed Nr. 74C.6)*, 

* in preparation for ELE...

Resistance table

• The following details are based on information from our suppliers and are merely to be viewed as guidance without warranty since the resistance will usually depend on several factors (quantity, exposure time, temperature etc.).

• Key
 + = resistant;
 0 = resistant under certain circumstances;
 - = not resistant

Part	Material	Petrol	Benzene	Diesel oil	Lubricating oils and greases	Mineral oils	Animal and vegetable oils	Weak lyes	Strong lyes	Weak acids	Strong acids	Spirit	Sea water
Adapter ring 22/30 mm	PA GV self-extinguishing	+	+	+	+	+	+	+	-	0	-	+	+
Front plate seal and sealing bellows	NBR	+	+	+	+	+	+	+	0	0	-	+	+
Bezels	ABS galv. chromed	+	0	+	+	+	+	+	+	+	0	0	+
Caps/symbol carriers	PA 12	+	+	+	+	+	+	+	-	0	±	+	+
Contact blocks	PA GV self-extinguishing	+	+	+	+	+	+	+	-	0	-	+	+
Mounting flange	PA GV	+	+	+	+	+	+	+	-	0	-	+	+
Plunger	PBT	+	0	+	+	+	+	+	0	+	-	+	+
Diffusers	PC film	+	-	+	+	+	+	-	-	+	0	-	+
Edging	PA GV	+	+	+	+	+	+	+	-	0	-	+	+
Selector switch knobs	ABS	+	0	+	+	+	+	+	+	+	0	0	+
Selector switch inhibit	ABS	+	0	+	+	+	+	+	+	+	0	0	+

Special device versions

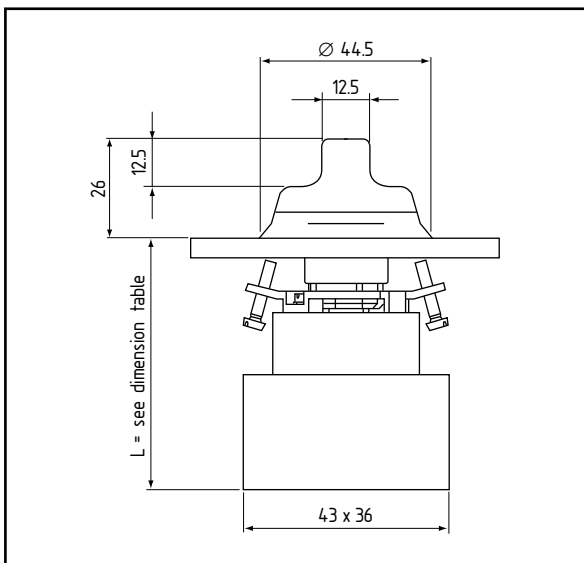
Step switch with 2 to 12 switching positions _____	40
Potentiometer drives _____	42
Control devices with position switches _____	43
Short-lift pushbutton _____	49
Rotary disconnects _____	52



Step switch with 2 to 12 switching positions



Figure: Type series N with sealing bellows color black (standard), color white (not shown): on request



Design

Step switches with 2 to 12 switching positions consist of a maintained selector switch device head and contact block in cam switch design with locating mechanism (without zero position).

The 2-step switch has 3 poles, all other versions have 1 pole.

If a zero position is required we recommend that step 1 (contact 1) be selected and not occupied.

Options

- .1 version with 46 mm long knob (refer to page 21 and product range)
- Labels: on request

Technical data	
Device heads	see above
Dimensions device heads	see above
Cam switches	Make: Kraus & Naimer, type series CA10
per step	1 NO contact (2-step switch, 3-pole)
Regulation	to IEC 60947-3 (VDE 0660 Part 107)
Insulation voltage U_i	690 V
Thermal rated current	20 A
Power	AC-23: 7.5 A AC-3: 5.5 A
Shock hazard protection	EN DIN 50274 (VDE 0660 Part 514)
Corrosion protection of the electrical parts	Corrosion protection for the electrical elements behind the front plate cannot be guaranteed.

Dimension table	
Number of steps	Installed depth L
2	69.5 mm
3	60.0 mm
4	60.0 mm
5	69.5 mm
6	69.5 mm
7	78.0 mm
8	78.0 mm
9	87.5 mm
10	87.5 mm
11	97.0 mm
12	97.0 mm

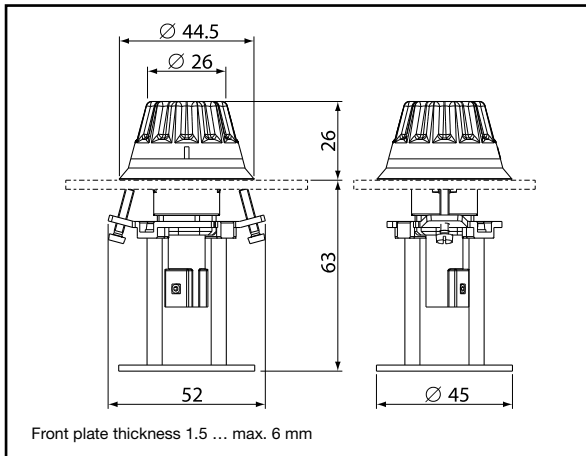
Product range				
Devices	Number of steps	Version	Part Number ¹	Ident. Nr.
Type series N	2		NWSE 2K	0803101
		with long knob	NWSE 2K.1	0803151
	3		NWSE 3K	0803100
		with long knob	NWSE 3K.1	0803150
	4		NWSE 4K	0803102
		with long knob	NWSE 4K.1	0803152
	5		NWSE 5K	0803104
		with long knob	NWSE 5K.1	0803154
	6		NWSE 6K	0803106
		with long knob	NWSE 6K.1	0803156
	7		NWSE 7K	0803108
		with long knob	NWSE 7K.1	0803158
8		NWSE 8K	0803110	
	with long knob	NWSE 8K.1	0803160	
9		NWSE 9K	0803112	
	with long knob	NWSE 9K.1	0803162	
10		NWSE 10K	0803114	
	with long knob	NWSE 10K.1	0803164	
11		NWSE 11K	0803116	
	with long knob	NWSE 11K.1	0803166	
12		NWSE 12K	0803118	
	with long knob	NWSE 12K.1	0803168	

¹ .1 version with 46 mm long knob

Potentiometer drives



- Version shortened behind the front plate: on request



Assembly instructions

A central hole fixing and two different three-hole fixings are provided to mount the potentiometer.

The potentiometers are not supplied and must be procured from the respective manufacturers.

Design

This device consists of a fluted knob and potentiometer receptacle with integrated mounting flange. The potentiometers themselves are not part of the product range.

The potentiometer receptacle already contains the mounting flange function, i.e. the device heads are therefore supplied without the standard mounting flange EFM of the EF/EL system.

The selector drives for potentiometers are supplied in two assemblies:

- Knob-operated switch with additional position display (arrow)
- Potentiometer receptacle with integrated mounting flange
- However, as complete unit with one type designation and part no.

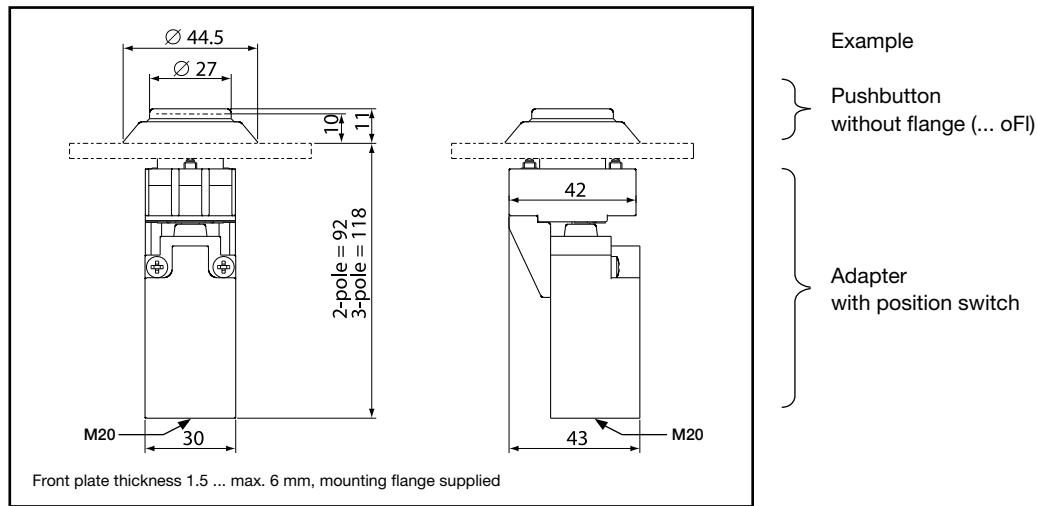
Technical data

Shaft diameter	up to 6 mm
Shaft length	30 ... 40 mm

Product range for selector drive for potentiometer

Devices	Color seal/ potentiometer handle	Part Number	Ident. Nr.
Type series N	black/black	NDAN 6	080 2200
	white/white	NDAN 6 WS	080 2201

Control devices with position switches



Design

For applications in which a high class of protection is also required behind the front plate, an adapter is available for the connection of position switches with type of protection IP 65 and IP 67 from the Elan SEK type series (position switches to EN 50 047, shape B, vertical plunger).

Actuating heads for the adapter solution include pushbuttons, mushroom buttons, single-plunger selector switches and spring return selector switches as well as EMERGENCY STOP control devices of version 1 (without EFR spring element).

SEK position switches are offered as 2-pole version with snap-action contacts (1 NC/1 NO contact) and with momentary contacts (1 NC/1 NO contact, 2 NC contacts, 2 NO contacts).

The adapter consists of the mounting flange for the device heads and a fixing bracket with position switch attached by the factory, i.e. the device heads are supplied without the standard EFM mounting flange from the EF/EL system.

Options (on request)

- 3-pole position switch versions

Assembly instructions

- Before assembly the position switch must be separated from the adapter in order to have access to the fixing level of the mounting flange and then screwed on again.
- In order to wire the position switch the device lid must be removed and then replaced.

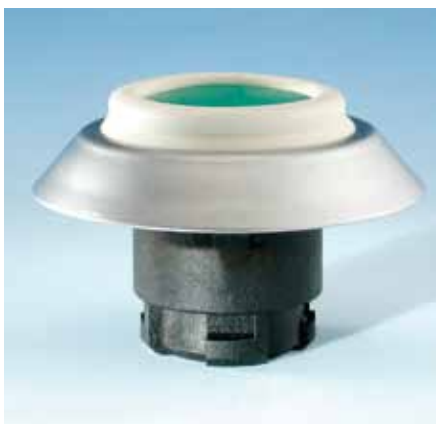
Control devices with position switches (continued)

Technical data for position switch SEK

Regulations (if applicable)	IEC 947, EN 60947, VDE 0660, EN 50047
Rated operating voltage U_o max.	400 V
Utilization category to VDE 0660 Part 200	AC-15, DC-13
Rated operating current I_o as dependent on utilization category and test voltage	8 A: AC-15, 250 VAC 5 A: DC-13, 24 VDC
Thermal rated voltage I_{th} (in air)	10 A
Short-circuit protection	gG 10 A
Air clearance and creepage to DIN VDE 0110/01.89	Degree of pollution 3 Overvoltage category III
Proof of positive opening	2.5 kV surge voltage
Contact system	4-path contact bridge with micro-movement through spring force, contact paths galvanically separated
Contact material	Fk-Ag, silver-plated, passivated
Contact force	0.5 N per contact point – 2 N per contact
Switching of small loads	minimum 24 VDC/10 mA
Chatter time	≤ 5 ms at 100 mm/s
Temperature range	–25... +80 °C
Climatic resistance to IEC EN 60068	Part 2-30
Installed position	random
Mechanical life to IEC EN 60947-5-1 (VDE 0660 Part 200)	30 × 10 ⁶ switching cycles
Switch path (lift)	approx. 6 mm
Impact resistance	30 g/18 ms
Vibration resistance	15 g/10 ... 200 Hz
Terminal designation to DIN EN 50005 or DIN EN 50013	yes
Actuating force at end of lift (1 NC/1 NO contact)	approx. 10 N
Housing material	PA 66 GV, self-extinguishing, hardly flammable
Terminal types	Screwed connection up to 2 × 0.5 ... 2.5 mm ² (with wire-end ferrule up to 1.5 mm ²) single and multicore
Rated isolated voltage U_i	440 V, test voltage 2,500 V
Type of protection for contact block	IP 67
Shock hazard protection of live parts	exists due to lid
Class of protection for the shock hazard protection in accordance with DIN EN 60947-1/A2	D
Approvals	CSA, UL

Product range for adapter with position switch			
Part Number	Contact complement	Diagram	Ident. Nr.
EFMH/SEK 103	1 NC/1 NO*		127 0019
EFMH/SEK 022	2 NO*		127 0026
EFMH/SEK 220	2 NC*		127 0027
EFMH/SEKP	1 NC/1 NO with snap-action function		128 7010

* Contacts with pulse function



- Devices as on page 18, but without mounting flange EFM/ELM
- Flange function in adapter

Product range for pushbutton for position switch installation					
Devices	Color	White sealing bellows		Black sealing bellows	
		Part Number	Ident. Nr.	Part Number	Ident. Nr.
Type series N	black	NDT SW oFI	080 0011	NDT GR/SW oFI	0800013
	yellow	NDT GB oFI	080 0016	NDT GR/GB oFI	0800018
	red	NDT RT oFI	080 0021	NDT GR/RT oFI	0800023
	green	NDT GN oFI	080 0026	NDT GR/GN oFI	0800028
	white	NDT WS oFI	080 0031	NDT GR/WS oFI	0800033
	blue	NDT BL oFI	080 0036	NDT GR/BL oFI	0800038
	gray	NDT GR oFI	080 0041	NDT GR/GR oFI	0800043

See above for adapter with position switch

Control devices with position switches (continued)



- Devices as on page 20 et seq. but without mounting flange EFM/ELM
- Flange function in adapter

Product range for spring return selector switches, single plunger for position switch installation					
Devices	Color of knobs	Color of sealing ring	Version	Part Number ¹	Ident. Nr.
Type series N	black	black	with long knob	NWT 21 oFI	0802001
	black	black		NWT 21.1 oFI	0802011
	white	white	with long knob	NWT 21 WS oFI	0802004
	white	white		NWT 21.1 WS oFI	0802014

Adapter with position switch: refer to page 45

¹ .1 version: long knob (46 mm), spring return selector switches with long knob require a grid dimension of 50 x 60 mm

Product range for maintained selector switch, single plunger for position switch installation					
Devices	Color of knobs	Color of sealing ring	Version	Part Number ¹	Ident. Nr.
Type series N	black	black	with long knob	NWS 21 oFI	0802061
	black	black		NWS 21.1 oFI	0802071
	white	white	with long knob	NWS 21 WS oFI	0802064
	white	white		NWS 21.1 WS oFI	0802074

Adapter with position switch: refer to page 45

¹ .1 version: long knob (46 mm), maintained selector switches with long knob require a grid dimension of 50 x 60 mm



- Devices as on page 23 et seq. but without mounting flange EFM/ELM
- Flange function in adapter

Product range for mushroom button for position switch installation

Devices	Color of button	White sealing bellows		Black sealing bellows	
		Part Number	Ident. Nr.	Part Number	Ident. Nr.
Type series N	black	NDP 50 SW oFI	0800711	NDP 50 GR/SW oFI	0800713
	yellow	NDP 50 GB oFI	0800716	NDP 50 GR/GB oFI	0800718
	red	NDP 50 RT oFI	0800721	NDP 50 GR/RT oFI	0800723
	green	NDP 50 GN oFI	0800726	NDP 50 GR/GN oFI	0800728
	white	NDP 50 WS oFI	0800731	NDP 50 GR/WS oFI	0800733
	blue	NDP 50 BL oFI	0800736	NDP 50 GR/BL oFI	0800738

Adapter with position switch: refer to page 45



- Devices as on page 24 et seq. but without mounting flange EFM/ELM
- Flange function in adapter

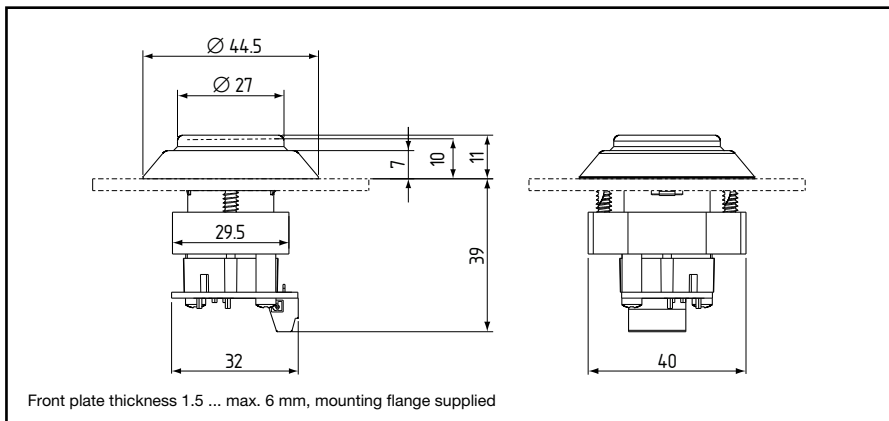
Product range for EMERGENCY STOP slam button for position switch installation				
Devices	Color of button	Color of sealing bellows	Part Number	Ident. Nr.
Type series N	red	white	NDRZ 50 RT oFI	0801287

Adapter with position switch: refer to page 45

Short-lift pushbutton



Type series N with sealing bellows
color white (standard), optionally in
black (not shown)



Design

In order to facilitate fatigue-free work with frequent actuation of pushbuttons, so-called short-lift pushbuttons supplement the product range. The actuation of the devices is limited to an ergonomic 2 mm switching lift with an actuating force of approx. 15 N.

The short-lift pushbuttons operate on the basis of an electromagnetic principle of action and are available as NC/NO contact combination (3 ... 50 V, max. 100 mA, NC contacts not positively opening).

Assembly instructions

- Complete delivery consisting of device head and keyboard contact block with mounting flange. Despite the similarity with pushbuttons, this is a different device design with restricted lift.
- Terminal system:
Screw terminals
- Conductor cross-sections:
 - rigid 0.14 ... 1.5 mm²
 - flexible 0.14 ... 1.0 mm²
- for screw-driver
0.4 x 2.5 mm.

Short-lift pushbuttons (continued)

Technical data		
Version	Actuating lift	restricted to 2 mm
	Actuating force	approx. 15 N
	Keyboard contact block	Make: RAFI, type RF 19
Electrical characteristics	Switching voltage min.	3 V
	Switching voltage max.	50 V
	Switching current min.	0.1 mA
	Switching current max.	260 mA
	Switching capacity max. (Ohmic load)	12.5 W
	Volume resistance in new state max.	100 mOhm
	Volume resistance after serviceable life max.	3 Ohm
	Chatter time max.	5 ms
Other details	Operating temperature min.	-25 °C
	Operating temperature max.	+70 °C
	Storage temperature min.	-40 °C
	Climatic resistance	to EN 60068 Part 2-20
	Serviceable	1 × 10 ⁶
	Corrosion protection of the electrical parts	A corrosion protection for the electrical parts behind the front plate cannot be guaranteed.

Product range for short-lift pushbutton, complete ¹					
Devices	Color	White sealing bellows		Black sealing bellows	
		Part Number	Ident. Nr.	Part Number	Ident. Nr.
Type series N	black	NDT 2 KHT SW	0800260	NDT 2 KHT GR/SW	0800262
	yellow	NDT 2 KHT GB	0800265	NDT 2 KHT GR/GB	0800267
	red	NDT 2 KHT RT	0800270	NDT 2 KHT GR/RT	0800272
	green	NDT 2 KHT GN	0800275	NDT 2 KHT GR/GN	0800277
	white	NDT 2 KHT WS	0800280	NDT 2 KHT GR/WS	0800282
	blue	NDT 2 KHT BL	0800285	NDT 2 KHT GR/BL	0800287
	gray	NDT 2 KHT GR	0800290	NDT 2 KHT GR/GR	0800292

¹ including contact block 1 NC/1 NO

Notes



Disconnect switches

Design features and properties

Application

A number of special design features and properties make this range (installation diameter: 22.3 mm) suitable for the following applications: applications in food processing machines to comply with the special cleaning requirements of this industry and to prevent the hygiene risk of cross-contamination, particularly with respect to machines processing raw goods such as fish, meat, poultry, milk or eggs.

The range has been designed under analogous consideration of EN 1672-2 "Food Machinery – General Design Principles – Part 2: Hygiene Requirements" as documented by a prototype test with the "hygiene" test certificate of the Prüfstelle der Fleischerei-Berufsgenossenschaft im BG-Prüfzert (Testing Agency of the Employers' Liability Association for the Butcher's Trade).

In addition to the advantages of the IP 69K type of protection and the cleaning friendly shapes of the device heads the following features deserve additional mention in terms of hygienic conformance design:

- Special seals extensively prevent the penetration of product residue in the gaps between the fixed and moving device parts, thereby effectively preventing the formation of bacteria nests in places which cannot be accessed for cleaning.
- Easy to clean due to
 - smooth surfaces and the extensive avoidance of areas on which residue could collect
 - selection of materials resistant to cleaning agents typical in the food processing industry such as smoke resin removers.
- Use of food-compatible materials only as a matter of course.

Easy to clean

The special shape of the devices, in which corners and edges are largely avoided and smooth surfaces have been created, make cleaning of the device heads simple and effective.

Type of protection IP 67/ IP 69K

All device heads satisfy the protection type tests

- IP 67 to EN 60529 (including protection from the penetration of water when constantly submerged, tested at 1 m water column/30 min.), and
- IP 69K to DIN 40050, Part 9 (1983)

Type of protection IP 69K

In addition to the test for dust-tightness the test for IP 69K (originally conceived as a protection type test for road vehicles) simulates the resistance of devices to high-pressure water cleaners by subjecting the test subjects to a hot (approx. 80 °C) water jet at very high pressure (approx. 100 bars) at 5 revolutions per minute without any damage occurring.

Main switch NHS 40 and NHS 63 in accordance with EN 60947-1 and EN 60947-3

- hygiene-compliant to EN 1672-2/ISO 13849
- class of protection IP 69K front side
- 3-pole
- front fixing 22.3 mm installed diameter
- for a front panel depth of max. 6 mm
- lockable
- black knob
- completely assembled on a stainless steel plate with 4 fixing bolts M5
- 2 versions with different power:
 - up to 40 A
 - up to 63 A

EMERGENCY STOP main switch NHS NH 40 and NHS NH 63

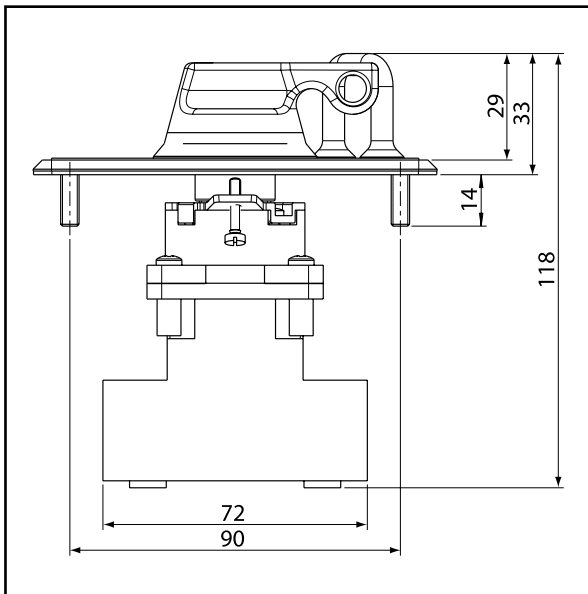
- Version as for NHS 40/NHS 63, but with red knob and yellow background and with the engraving O-I.

The scope of delivery of a complete device contains the stainless steel panel with 4 threaded bolts, the name plate O-I, the fixing bracket for locking and the rear-side main switch with the main flange (as shown on page 53).



Disconnect switches

Design features and properties

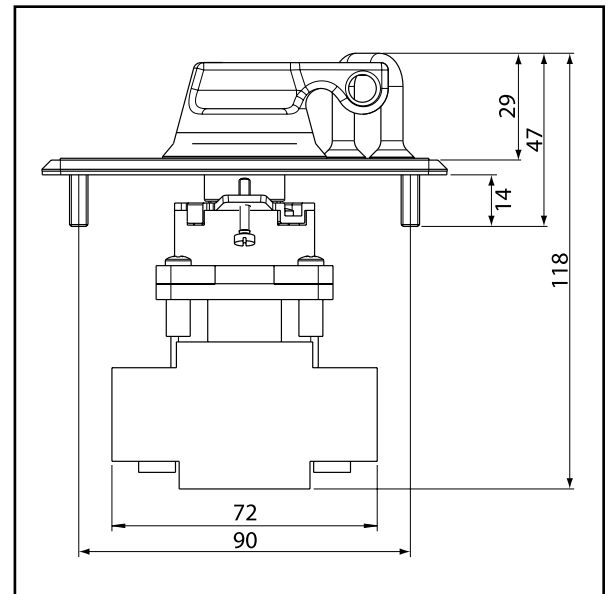


Product range

Article	Part Number	Ident. Nr.
Supply disconnecting device with black handle		
- up to 40 A	NHS 40	080 8000
- up to 63 A	NHS 63	080 8015

Remarks:

- The lock is not part of the scope of delivery.
- Individual components or neutral conductor models on request.



Product range

Article	Part Number	Ident. Nr.
Emergency switching off device with red knob and yellow background		
- up to 40 A	NHS NH 40	080 8020
- up to 63 A	NHS NH 63	080 8025

Remarks:

- The lock is not part of the scope of delivery.
- Individual components or neutral conductor models on request.

Disconnect switches

Design features and properties

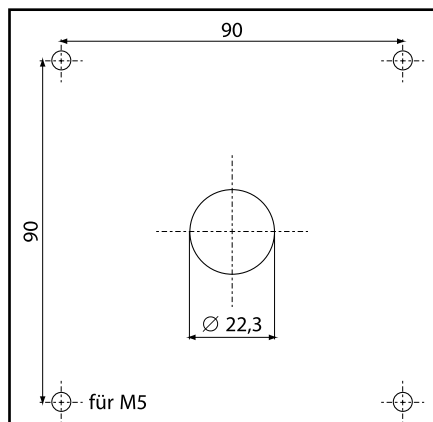
Technical data

Type	on/off switch, 3-pole		
Standards	IEC 60947, EN 60947, IEC 60204, EN 60204, UL 508, CSA 22.2 No. 14		
Mechanical lifespan	> 10 ⁵ switching cycles		
Climatic resistance	damp heat: constant to DIN IEC 60068-2-3; cyclic to DIN IEC 60068-2-30		
Ambient temperature	open +25 °C ... +50 °C; enclosed -25 °C ... +40 °C		
Load carrying capacity in intermittent operation, class 12	AB: 60/40/25%; ED: 1.3/1.6/2 x I _s		
Operational voltage U _s	690 VAC		
Impulse withstand voltage U _{imp}	6 kV		
Uninterrupted current I _U /I _{n/line}	NHS 40, NHS NH 40: 40 A; NHS 63, NHS NH 63: 63 A		
Short-circuit rating max. fuse	NHS 40, NHS NH 40: 40 gl; NHS 63, NHS NH 63: 63 gl		
Conditional short-circuit current	16 kA _{eff}		
Isolation characteristics acc. to EN 60947	up to 690 VAC		
Switching angle contacts	90° (8 current paths)		
Terminal capacity			
– solid or stranded	NHS 40, NHS NH 40: 1 mm ² ... 10 mm ² NHS 63, NHS NH 63: 4 ... 16 mm ²		
– flexible or multiwired including ferrule	NHS 40, NHS NH 40: 0.76 mm ² ... 6 mm ² NHS 63, NHS NH 63: 2.6 ... 10 mm ²		
American wire gauge	NHS 40, NHS NH 40: 8 AWG; NHS 63, NHS NH 63: 6 AWG		
Operational current I _s AC-21 A	NHS 40, NHS NH 40: 40 A NHS 63, NHS NH 63: 63 A		
UL/CSA general use, 600 VAC	NHS 40, NHS NH 40: 40 A NHS 63, NHS NH 63: 60 A		
Operational power at 50–60 Hz, 3-phase		NHS 40, NHS NH 40	NHS 63, NHS NH 63:
– AC-23A	220 ... 240 V	7.5 kW	16 kW
	380 ... 440 V	15 kW	22 kW
	500 V	15 kW	22 kW
	660 ... 690 V	15 kW	22 kW
– AC-3	220 ... 240 V	5.5 kW	11 kW
	380 ... 440 V	11 kW	22 kW
	500 V	11 kW	22 kW
	660 ... 690 V	11 kW	22 kW
– UL/CSA	110 ... 120 VAC	3 HP	5 HP
	210 VAC	7.5 HP	10 HP
	240 VAC	7.5 HP	15 HP
	480 VAC	15 HP	30 HP
	600 VAC	15 HP	40 HP

Mounting Instructions

The main switch is supplied preassembled (as shown on page 53). The two terminal screws on the rear side towards the front panel must be removed so that the front part can be separated from the switch. Five boreholes according to the diagram are necessary to fix the front part (4 x for the threaded bolts M5 and 1 x 32.3 mm for the knob).

The front part including knob is pushed into the corresponding boreholes from the front and attached at the back using the 4 threaded bolts M5. The main switch is reconnected to the knob in the bayonet and fixed at the back to the front panel using the two screws. The maximum front panel thickness is 6 mm (without stainless steel plate/sealing supplied).



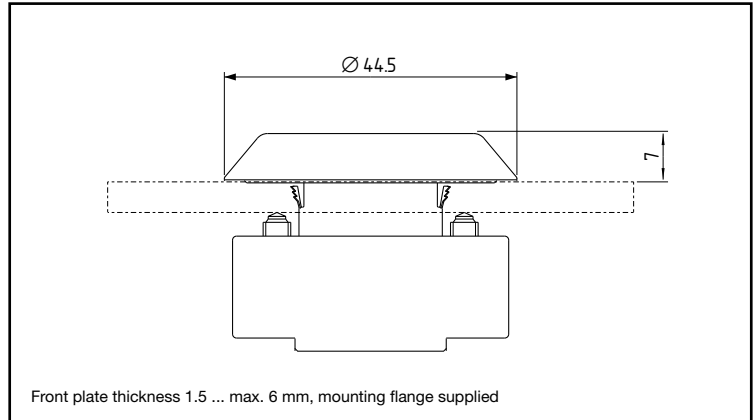
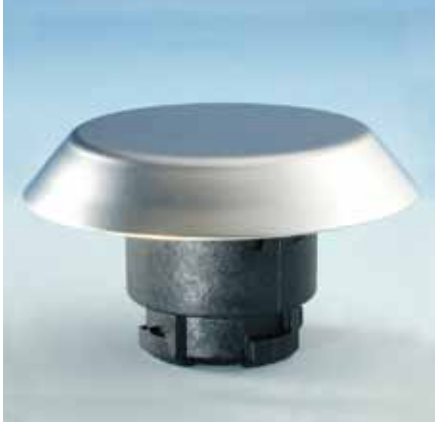
Accessories/symbols

Blanking plug	56
Adapter	56
Labels	57
Protective collar against unintentional contact	58
Individual parts/accessories	59
Symbols	60



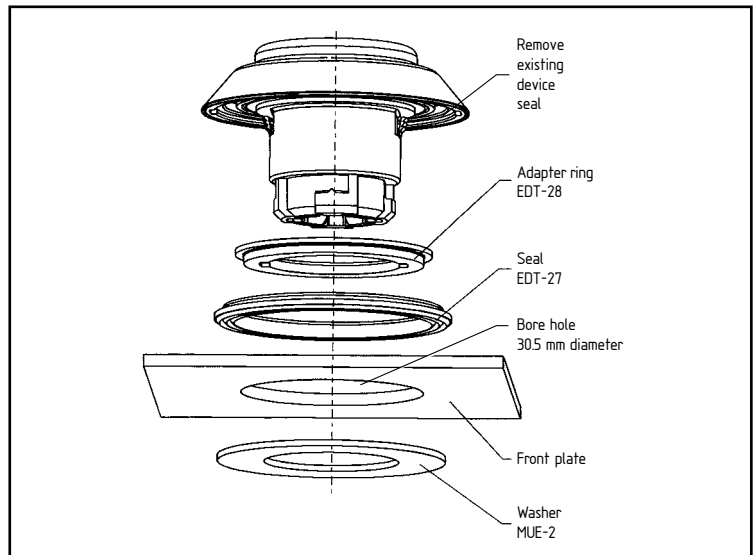
Accessories

Blanking plug



Product range			
Device	Color	Part Number	Ident. Nr.
Blanking plug	silver	NB	0800300

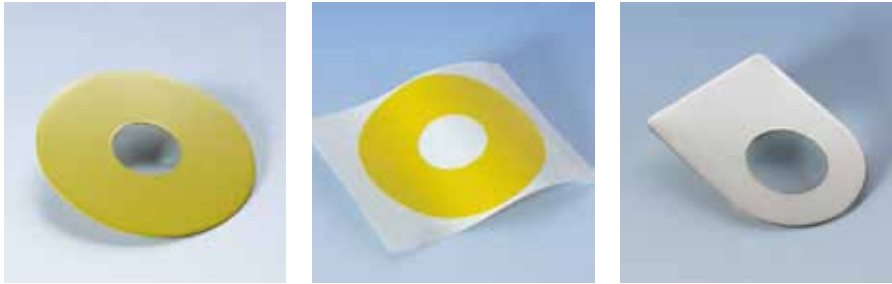
Adapter



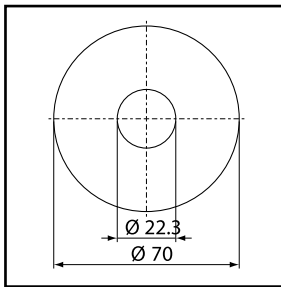
Product range		
Device	Part Number	Ident. Nr.
Adapter 22/30 mm	NUE ¹	0809000

¹ consisting of: adapter ring EDT-28, seal EDT-27, washer MUE-2

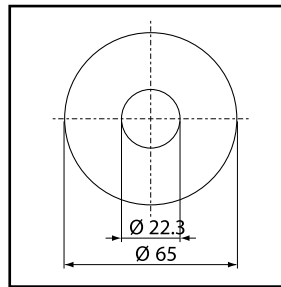
Labels



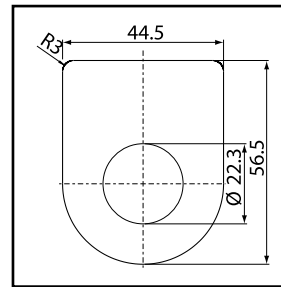
- EMERGENCY STOP label
- left: outer diameter 70 mm, V2A version, color yellow, self-adhesive without lettering
 - not shown: ditto, but with lettering EMERGENCY STOP (additional lettering: on request)
 - center: outer diameter 65 mm, plastic foil, color yellow, self-adhesive without lettering



NDP-70



NDP-65



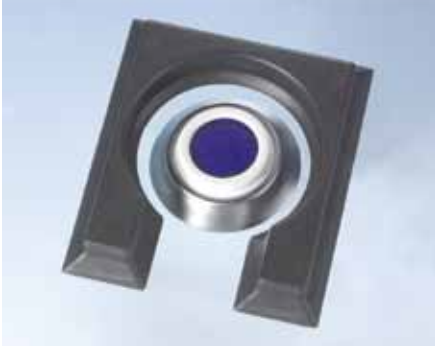
NZSO

Labels

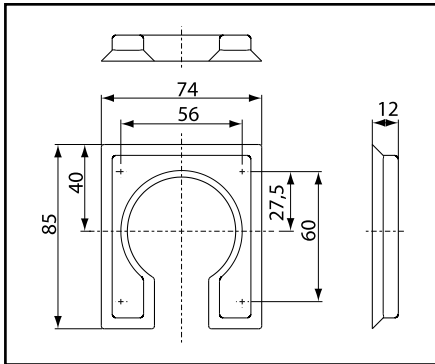
- right: V2A version without lettering, self-adhesive

Product range		
Version	Part Number	Ident. Nr.
EMERGENCY STOP label, outer diameter 70 mm, V2A version, color yellow, self-adhesive without lettering	NDP-70	0801310
ditto, but with lettering EMERGENCY STOP	NDP-70/EMERGENCY-STOP	0801312
EMERGENCY STOP label, outer diameter 65 mm, plastic foil, color yellow, self-adhesive, without lettering	NDP-65	0801300
Label, H 56.5 mm, B 44.5 mm, V2A version, blank	NZSO	0809020
ditto, 1 line with lettering	NZSO/1	0809021
ditto, 2 lines with lettering	NZSO/2	0809022

Protective collar against unintentional contact



- for pushbuttons and illuminated pushbuttons
- supplied without control device



NSK-..

Product range		
Version	Part Number	Ident. Nr.
Protective collar, color black	NSK-GR	0803040
Protective collar, color white	NSK-WS	0803041

Individual parts/accessories

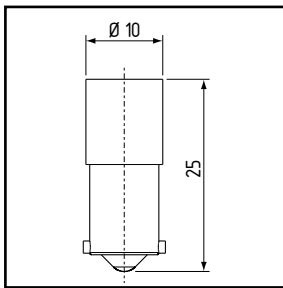


- Multi-LEDs**
- with Ba9S socket
 - color white
 - operating voltage 24 VDC
 - serviceable life $\geq 10,000$ hours (in accordance with manufacturer's information, but without guarantee)
 - Ba9S bulbs: on request¹

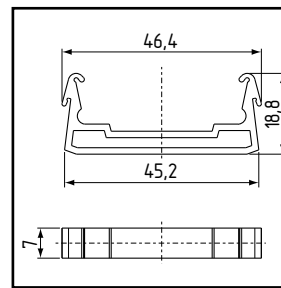
1) The use of bulbs is not recommended due to the necessity to change the bulb behind the front plate (refer also to page 4)



- Snap-on cover**
- Measure to protect against contact in the case of illuminated pushbuttons with shock hazard operating voltage. The snap-on cover covers unused mounting flange positions and prevents contact with live parts.



LE 24/9 WS



EL-15

Product range		
Version	Part Number	Ident. Nr.
LED white, Ba9S holder, 24 VDC	LE24/9 WS	069 0030
Snap-on cover	EL-15	071 3005
Add-ons		
Print on pushbutton*	NBSY	080 9010
Hot embossing on pushbutton (on request)	NHSY	080 9014

* For symbols refer to page 60 et seq.

Availability:

- Symbols can be added to the face of NDT pushbuttons or NDL illuminated pushbuttons, only.
- See below for available symbols and associated codes.
- IEC 60417-1/2 symbols on request.

Methods:

- Tamp-on printed, suffix "B"
- Hot embossed, suffix "H"

Inks used are non-toxic and are baked on to increase wear resistance.

Ordering:

To place an order for a pushbutton with a custom printed symbol, add the symbol code and method suffix to the end of the part number.

Order Example:

Green push button with "on" symbol...










printed:

NDT GN/501B













hot embossed:

NDT GN/501H

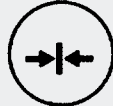





Linear motions

	101 Working motion feed		102 Rapid motion or idling		103 Rapid motion		104 Feed
	105 Interrupted motion jogging		106 Reciprocating motion				
	107 Limited motion		108 Indexing		109 Motion in two directions		

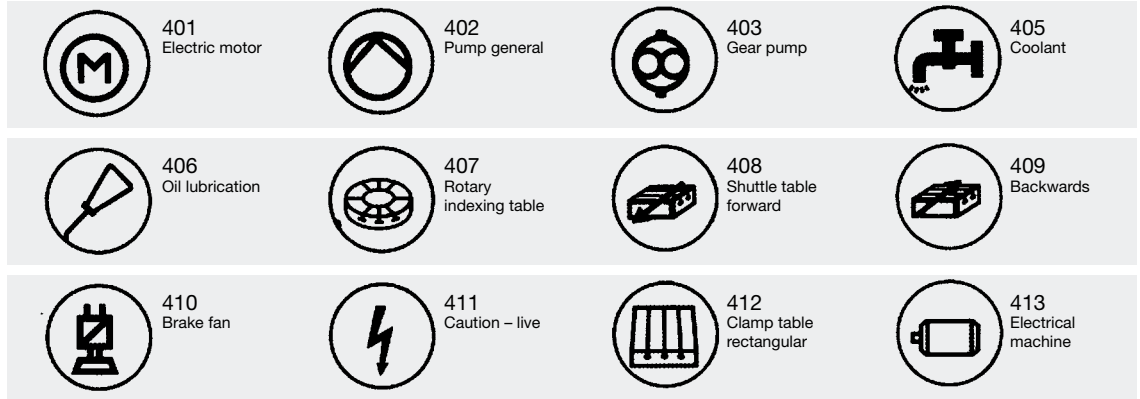
Rotary motions

	201 Continuous clockwise rotation		202 Counter-clockwise rotation		203 Clockwise rotation stop		204 Counter-clockwise rotation stop
	205 1 revolution clockwise		206 1 revolution counter-clockwise		207 Rotary indexing		208 Interrupted rotary motion
	209 Clockwise motion restricted		210 Counter-clockwise motion restricted		211 Clockwise motion from a restriction		212 Counter-clockwise motion from a restriction

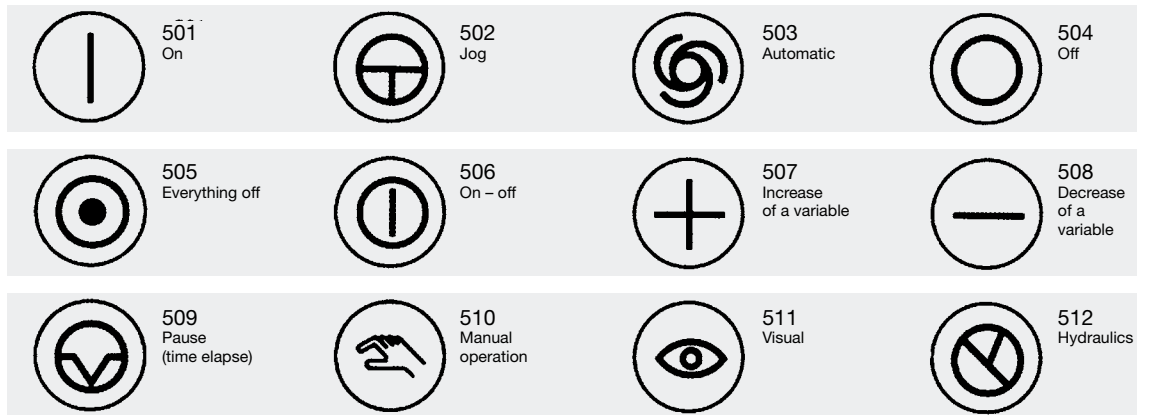
Additional options

	301 Clamping, chucking		302 Release		303 Braking		304 Release brake
	305 Unlock		306 Lock				

Drives



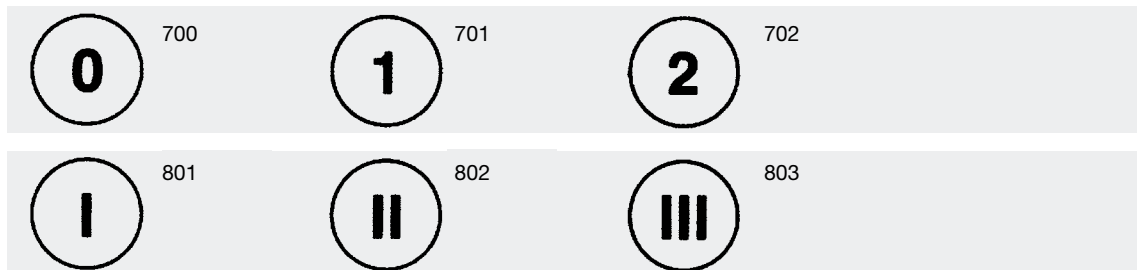
Signals



Words



Arabic numerals*



* Other numerals available, e.g. part no. 709 for number 9

Notes



Mounting boxes (command boxes)

Dimensions	64
Design	66
Option	66
Technical data	67
Product range	67

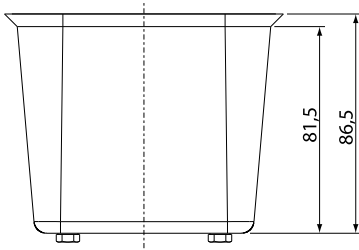
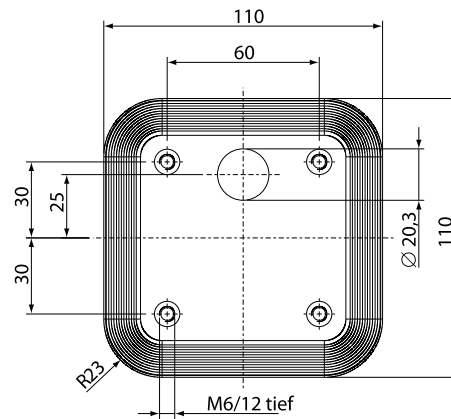
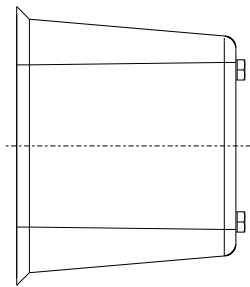
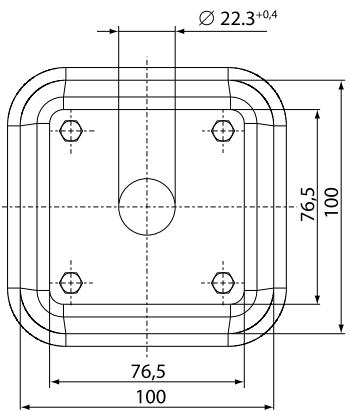


Mounting boxes (command boxes)

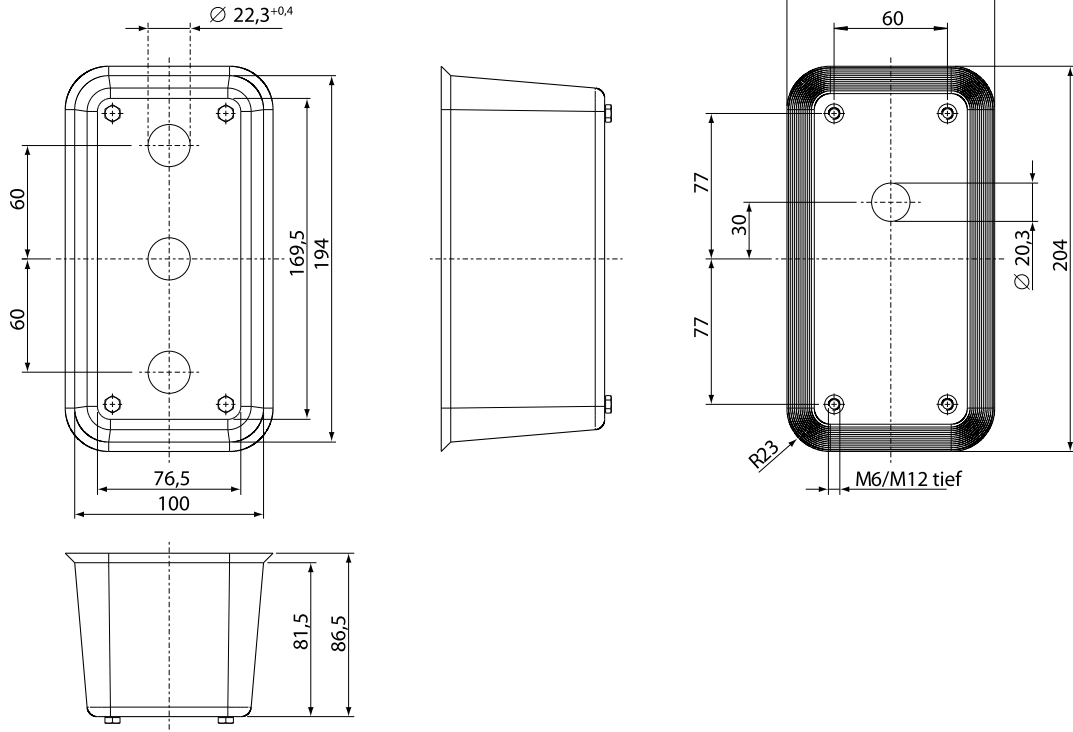


- Empty housing made of V4A material
- Design under consideration of EN 1672-2 and ISO 14 159
- Versions for 1, 3 and 5 control points for installation diameter 22.3 mm
- Equipped versions: on request

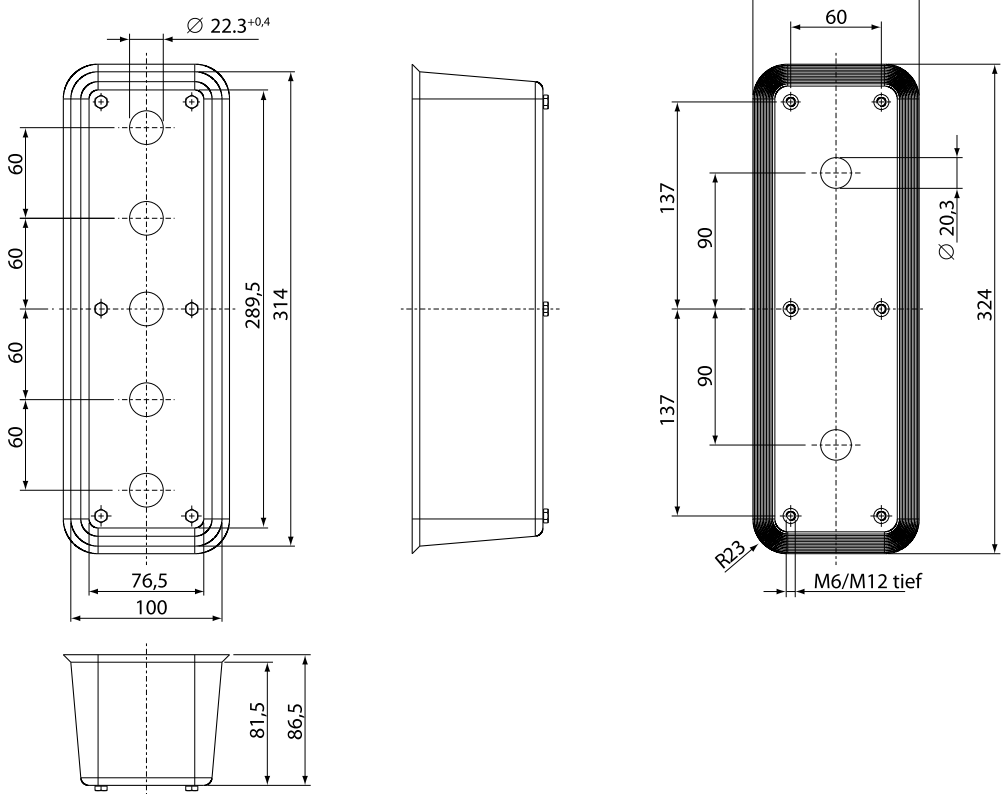
Dimensions of empty housing with 1 control point



Dimensions of empty housing with 3 control points



Dimensions of empty housing with 5 control points



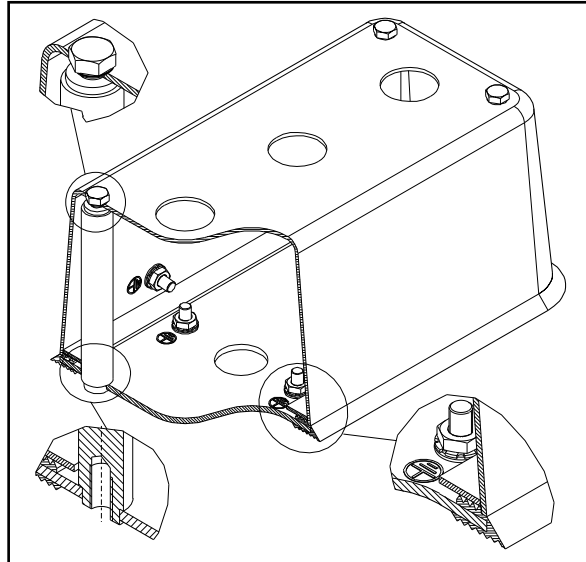
Design

The mounting boxes (control boxes) of the type series NBG (for food processing machines and MBG...O for heavy-duty applications and similar) consist of a housing top part made of V4A material produced using a special deep-drawing process and a bottom part. Versions are available as empty housing with bore holes for 1, 3 and 5 control points (installation diameter: 22.3 mm).

The bottom part of the housing (with 2 earthing screws) has a special seal which covers the edges of the top part of the housing (with 1 earthing screw) and all sides of the bottom part of the housing. The seal for the type series NBG is made of food-safe NBR and in the type series MBG...O from UV and ozone-resistant NBR.

The top and bottom parts of the housing are connected by means of V4A hexagonal screws M 5 x 10 (to ISO 4017 or DIN 933). Under hygiene aspects the screws comply with EN 1672-2 and ISO 14159. With respect to tightness, the screw bushing is additionally protected with special washers (PA) and with an inner O ring (similarly made of food-safe NBR).

The housing is fixed via 4 or 6 threaded boreholes – depending on version – M 6/12 deep. The corresponding screws (M 6) are not supplied.



Option (on request)

- Mounting box equipped with control and indicator devices
- Other installation bore holes
- Other cable glands (refer to assembly instructions)

Assembly instructions

In order to guarantee the class of protection IP 67 and IP 69K for the housing the cable entry is provided via the bottom part. For this purpose there is a cable entry with a diameter of 20.3 mm for boxes with 1 and 3 control points for a cable gland M 20 x 1.5 mm and for 5 control points there are 2 x cable entries with a diameter of 20.3 mm.

Depending on circumstances, we recommend a cable gland with an adequate class of protection.

In the case of different cable entries in the top part of the box a cable gland with class of protection IP 65 and IP 67 or IP 69K may be necessary. While cable glands with type of protection IP 65/IP67 are numerous on the market, cable glands with class of protection IP 69K are very rare.

Please remember that a cable entry in the top part of the box is bored at a 90° angle to it and that therefore the cable entry is not flush with the fixing surface.



Technical data

Version	Under consideration of EN 1672-2 and ISO 14 159 largely avoiding corners and edges with radiuses >6 mm
Type of protection	IP 67 and IP 69K*
Material	NIROSTA 1.4571 (AISI 316Ti)
Use of the material	Food processing machines, apparatus and components of the chemicals industry, textiles industry, cellulose manufacture, dye works as well as in the photo, paint, artificial resin and rubber industry
Corrosion resistance class	III medium (structures with moderate chloride and sulphur dioxide exposure from industry, traffic and sea water atmosphere; a concentration of pollutants must be avoided)

* In connection with control devices and illuminated pushbuttons of the type series N and O (or suitable integrated devices) as well as cable glands of the appropriate class of protection or a suitable positioning of the cable gland outside the critical area.

Product range

	Device	Seal	Version	Part Number	Ident. Nr.
Type series NBG for food processing machines	Empty housing with bore holes	gray	for 1 control point	NBG 311	0809500
			for 3 control points	NBG 633	0809510
			for 5 control points	NBG 665	0809520

Notes



22.3 mm & 30.5 mm Industrial-Grade Joystick Controls



Spring-return joystick switches

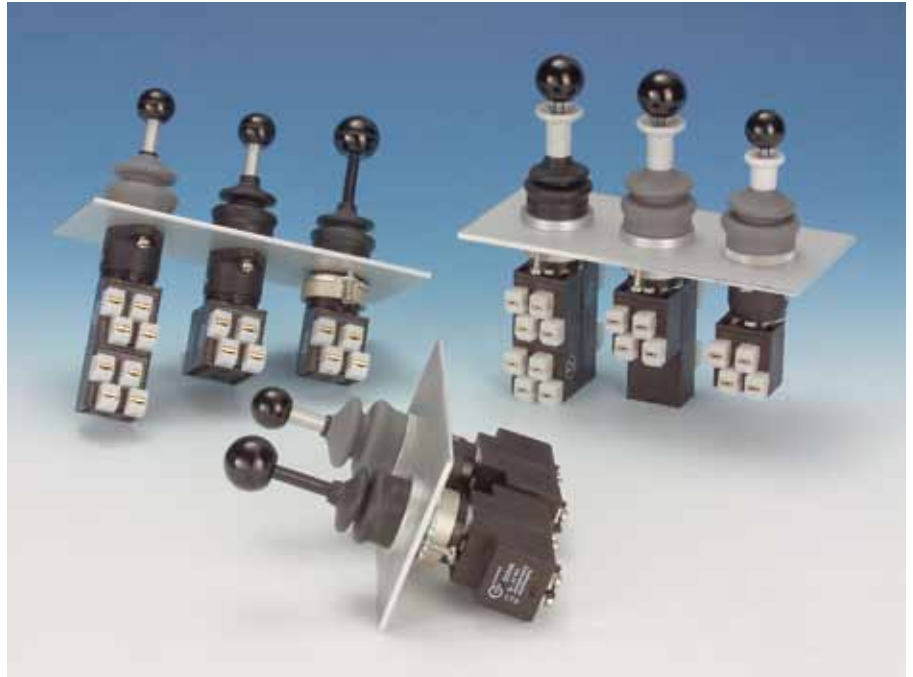
Spring-return joystick switches belong to the group of special device designs in the Schmersal delivery range of command and indicator devices.

Spring-return joystick switches – optionally for 22.3 mm or 30.5 mm installation diameters – consist of an actuating head with actuating lever movable in up to 4 directions, and the appertaining contact elements.

The movement of an actuating lever is transmitted in the actuating head through special switching curves to a linear movement and passed on through plungers in the contact elements (at the bottom of the devices) and processed there to digital or analog switching signals.

Protection class IP 69K

These joysticks have 2mm thick silicone sealing bellows which meet the protection class requirements IP 69K in accordance with DIN 40050 Part 9 (1983).



Protection class test IP 69K: in addition to the test for dust proofness, the test for IP 69K (originally intended as the protection class test for road vehicle construction) specially simulates the resistance to high-pressure cleaning of devices by splashing the tested devices at approx. 5 revolutions per minute under greatly increased pressure (approx. 1450psi/100 bar) with an 176°F (80°C)-hot jet of water without causing any damage.

Applications

Compared to many other joystick controls, Schmersal devices are distinguished by their optimized sturdiness, construction size and functionality for applications in the construction of machinery and commercial vehicles.



Typical applications include machinery in the food industry or process engineering ... but also tail lifts in commercial vehicles, lifting work platforms, airport tugs and apron vehicles.

In contrast to the smaller devices, these devices are particularly suitable for rough industrial applications including outdoor use. Compared to multifunctional devices, familiar for example in crane controls and forklift trucks, they are of a much smaller construction – with limited functionality.



Information

on applications:

As the constructions for 30.5 mm installation diameter allow more generously sized designs in the components used, these devices are recommended in particular for applications that have to satisfy the highest reliability requirements on account of their functional and environmental stresses.



Sealing bellows

	Silicone thick-walled (WKT-26)
Material thickness	approx. 2 mm
Material properties	rupture proof
Protection class (front)	IP 67/IP 69K
Ambient temperature	-40 ... +80 °C
Mechanical service life	0,5 x 10 ⁶
UV/ozone resistance	Very good
“Outdoor” suitability	Very good

“Outdoor” applications

In devices with cryogenic fitness (-40 °C) that are preferably suitable for “outdoor” applications special grease is put on the device plungers (both in the actuating heads and also in the contact elements).

This additional measure prevents condensation water freezing (with the resulting risk of blocked actuating plungers) if the devices are exposed during use to temperature changes around the freezing point.

Resistance of the sealing bellows

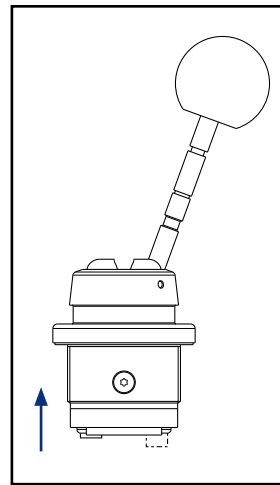
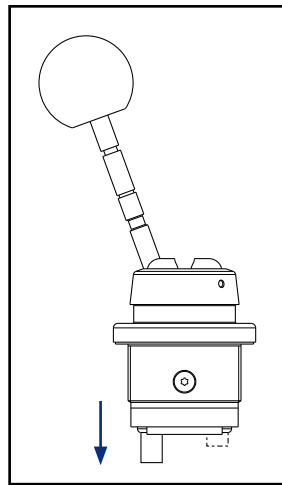
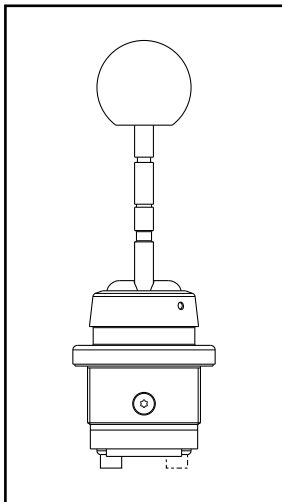
Silicone	
Weather, ozone	excellent
Food	physiologically safe
Solvent, chemicals	good to satisfactory

Modes of operation

The spring-return joystick switches generate digital switching signals on the basis of electromechanical principles of action in the end position for each direction of actuation, designed optionally as NC and/or NO contacts depending on the contact elements they have. A contact element consists here of two galvanically isolated switching contacts in each case.

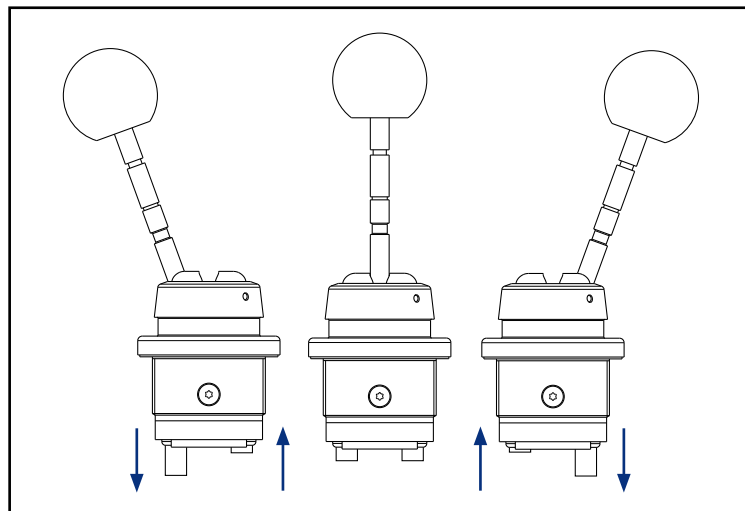
Devices with analog switching signals:
see loc. cit.

To generate switching signals one or two plungers in the device heads act on the electromechanical contact elements. The interaction is designed in such a way that the contact bridges in the position of rest (the devices' position when not actuated) are pretensioned under spring force.



- ▲ If the actuating lever is now moved in the direction of the end position, one of the actuating head plungers moves by means of the actuating force against the force of the contact element's resetting spring, i.e. a positive lifting movement arises that closes or opens the switching contacts – in each case depending on the contact elements.
- ▲ If on the other hand the actuating lever moves in the direction of the other end position, this actuating head-plunger moves in a non-positive (negative) lifting movement, which closes or opens the other of the two switching contacts – depending on the contact elements.

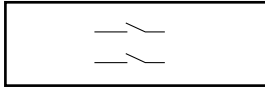
- ▼ In 2-plunger device head designs the plungers' lifting movements are inverted, i.e. one plunger moves further out (and performs a positive lifting movement) while the other plunger moves in (and performs a negative lifting movement).
- ▼ Each of the plungers can act optionally either on one contact element or on two (arranged one under the other). This means that depending on the fitted contact elements up to 4 NO switching signals are possible for each direction of movement.



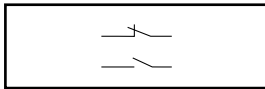
Contact system and markings

In the delivery range there are three types of contact elements available, which – with due consideration to the contact bridge pre-tensioning (see page 72) – generate the following switching signals in each case:

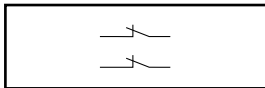
- 2 NO contacts,



- 1 NC/1 NO contact,



- 2 NC contacts.



Safety note: Positive-opening contacts

Switching contacts, which are opened by the described positive lifting movement, correspond in their safety quality to positively opening contacts in conformance to IEC EN 60947-1-1 or control category 1 under EN 954-1. All other switching signals correspond to control category B in accordance with EN 954-1 and may only be used for operational control signals. Additional measures in the sense of EN 60204-1 number 9.4 (control functions in case of a fault) might be necessary.

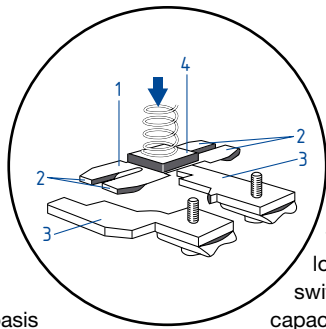


Devices for 22.3 mm and 30.5 mm installation diameters

With reference to IEC 60947-1 and IEC 60947-5-1 the devices are offered with the option of 22.3 mm or 30.5 mm installation diameter (with a mounting grid to other command and indicator devices of 40 x 55-mm and – from spring-return joystick switches – of 80 x 80 mm

In all devices the maximum switching angle is approx. 20°.

The permissible front plate thickness in devices for installation diameter 22.3 mm is in the range of 1.5 ... 6 mm and in devices for installation diameter 30.5 mm in a range of 1.5 ... 10 mm.



Contact system

The special design feature of the contact system is the mode of operation on the basis of what is referred to as the Schmersal four-way contacts, i.e. the contacts are doubly interrupting (1) and designed with 4 contact making points (2) each, which are parallel (as twin contacts) and also cross operating (as H bridge).

The resulting contacting factor of 4 – in conjunction with a high specific contact pressure – assures the highest reliability in perfect contact making.

Micro movements in the spring contact bridge on the stationary contact making points that have the effect of self-cleaning also assure the long-term functioning of this property, which is particularly important in electronic control circuits.

Terminal markings

The devices are provided with stickers – on the side of the contact elements – that indicate the function of the switching contacts in the position at rest (in the non-actuated position of the device lever).

NO contacts (contact marking 13/14) are in this case “green” and NC contacts (contact marking 11/12) have “red” shading. The upper contact marking refers to the upper switching contact and the lower contact marking to the lower switching contact for each contact element.

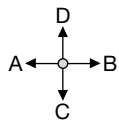
The contacts’ lower switching capacity is 24 VDC/5 mA and the upper switching capacity in AC-15-operation is 230 V/6 A.

The fixed contacts (3) are made of silver-plated brass material and the contact bridge of band welded phosphorous bronze. The contact points consist of fine silver and are accordingly particularly suitable for switching smaller currents. As protection against corrosion all contact parts are also gold-flashed.

The switching contacts are galvanically isolated from each other (4), i.e. the contact elements can also be used in circuits with different voltage potential.

Positively opening contacts:
See safety information (page 5).

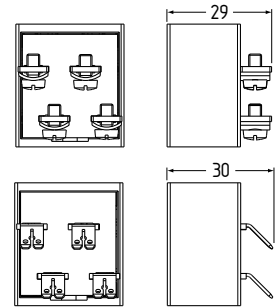
To determine which switching contacts act in the respective direction of actuation, the switching direction is marked A, B, C and D on the device ring with reference to the following diagram.



Corresponding to this the switching direction marking A, B, C and D is found on the stickers and it is mandatory to place these at the letter C on the device ring as the proper assembly position.

Connection technology/ Protection against accidental contact

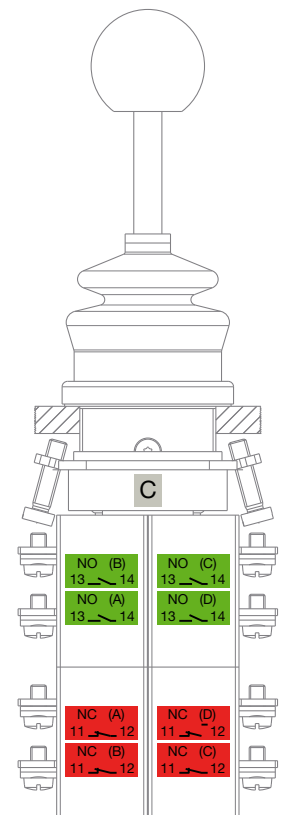
The devices are optionally supplied with open self-lifting screw terminals M 3.5 (with contact protection) or flat-pin plug connections 1 x 6.3 x 0.8 mm (or 2 x 2.8 x 0.8 mm) (without contact protection).



Caution:

- If operating the devices with shock-hazard voltage (see EN DIN 50274 or VDE 0660 Part 514), additional measures are essential for protection against accidental contact. For this purpose slip-on (natural-colored) shock-hazard protection caps are included in the scope of supply for the screw terminals.
- in the case of flat-pin plugs, you must either use commercially available insulated flat-pin plugs or take other protective measures.
- When fitted, actuating heads and contact elements are insulated from the front plate.
- Additional earthing is necessary for devices with metal housing (option as part of the delivery range for 30.5 mm installation diameter).

For production technology reasons the contact sequence marking on multi-way devices in accordance with IEC 60947-1 (13/14, 23/24 and following pages, 11/12, 21/22 and following pages) is not possible or only possible on request.



Spare parts

	Type series MK... (installation-Ø 22.3 mm)		Type series WK... (installation-Ø 30.5 mm)	
	Part number	Ident. number	Part number	Ident. number
Silicone sealing bellows – 2mm	MKT-U1/WKT-26	021 6015	On request	
Assembly flange	—		MF15	071 7100
Locking nut with serrated lock washer	—		MU/FS30	071 7851
Analog elements with fixing screws	EO24AK.11		EO24AK.11	

Assembly information

Devices for installation diameter 22.3 mm are supplied pre-assembled in the form of what is known as a basic device (1) – consisting of the contact element(s) and the actuating head mechanism in one part – and the spring return joystick handle (2) – consisting of the device knob with sealing bellows, actuator ball and knurled nut including sealing.

The basic device (1) is inserted from the rear of the front plate into the installation diameter and tightened securely by means of the knurled nut (3) on the front of the assembly (2). Both the knurled nut and also the ball

(4) must be unscrewed at the same time.

First, the fixing screws on the basic device (5) must be twisted back until flush so that the maximum front plate thickness of 6 mm is available. The fixing screws serve in this case exclusively as an anti-twist lock and must therefore be tightened evenly (lightly) after assembling the device.

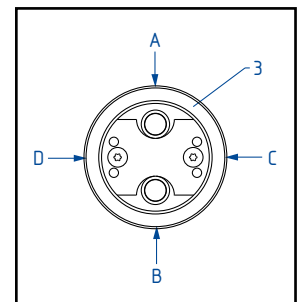
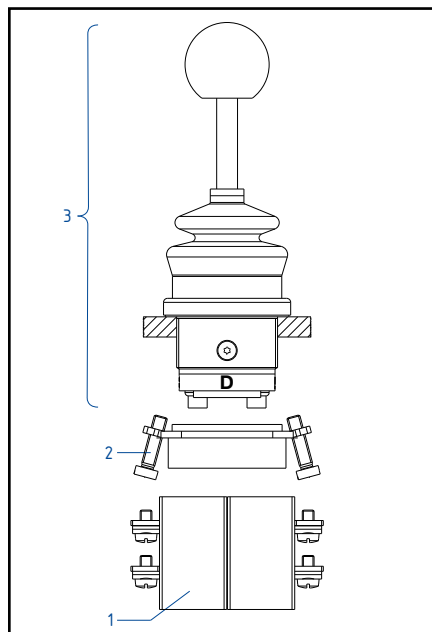
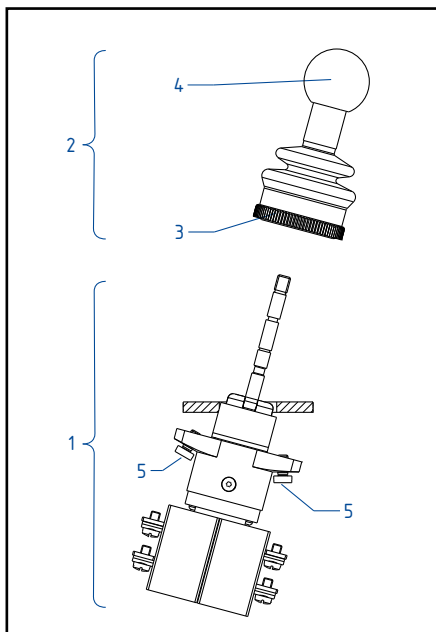
Devices for installation diameter 30.5 mm are supplied complete in an assembly but the contact elements (1) and the assembly flange (2) must be dismantled before assembly.

The actuating head (3) is then fastened to the assembly flange (2) – as with commercially available control devices – (on request: with an M30 nut).

The loosened contact elements (1) are then screwed on again. Make sure the assembly position of the contact elements is correct (i.e. it is mandatory to match the switching direction marking A, B, C and D on the stickers to the letter C on the device ring).



Caution: Damaged sealing bellows can impair the device's correct functioning and must therefore be replaced as quickly as possible.



Actuating elements		
Type series	MK...	WK...
Regulations (where applicable)	IEC EN 60947-1 (DIN VDE 0660 Part 100), IEC EN 60947-5-1 (VDE 0660 Part 200)	see left (type series MK...)
CE conformity	in accordance with Directive 89/336/EEC	see left (type series MK...)
Installation-Ø (in accordance with IEC EN 60947-1)	22.3 mm + 0.4 mm	30.5 mm + 0.5 mm
Front plate thickness	1.5 ... 6 mm	1.5 ... 10 mm
Mounting grid	80 × 80 mm	see left (type series MK...)
Fastening means	knurled nut	Assembly flange MF15***
Max. torque for fixing screws	./.	approx. 0.6 Nm
Temperature range	-40 °C ... +80 °C with silicone bellows	see left (type series MK...)
Protection class	IP 69K in accordance with DIN 40050 Part 9 (high-pressure cleaner proof) for devices with thick-wall silicone lining	see left (type series MK...)
Type of sealing	sealing bellows	see left (type series MK...)
Full insulation	yes	yes*
Materials	aluminium anodised, PA GV, POM, Silicone, Duroplast; stainless steel plastics: fibreglass reinforced, self-extinguishing	Plastic housing** see left (type series MK...)
Bezel design	pivoted part, aluminium anodised	Metal bezel
Actuating force	approx. 11 N	see left (type series MK...)

* with the exception of the special design with metal housing

** Metal housing: on request

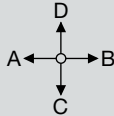
*** M30 nut/serrated lock washer: on request

Contact elements ENA	
Rated insulation voltage U_i	440 V, test voltage in accordance with EN 60947-1 Table 12 A: 1,890 V
Rated operational current I_o depending on the utilisation category and test voltage	8 A, AC-15, 250 VAC 5 A, DC-13, 24 VDC
Thermal nominal current I_{th} (in air)	10 A
Short-circuit protection in accordance with EN 60269-1	gG 10 A slow
Airgap creepage in accordance with EN DIN 60664-1	4 kV/3
Galvanic isolation of the contact bridge	yes
Proof of the positive opening	2.5 kV surge voltage
Travel for positive opening	approx. 2 mm after reaching the opening point
Switching of small loads	24 V, 5 mA
Switching frequency	1,200 s/h
Climatic proofing in accordance with IEC EN 60068	Part 2-20
Installation position	any position

Contact elements ENA (continued)

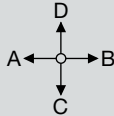
Mechanical service life in accordance with IEC EN 60947-5-1 (VDE 0660 Part 200)	10 dia. 10 ⁶ operations
Shock resistance	110 g/4 ms – 30 g/18 ms, no bouncing
Vibration immunity	>20 g/10 ... 200 Hz
Bouncing time (100 mm/s)	<5 ms
Housing material	PA GV; plastics: fibreglass reinforced, self-extinguishing
Terminal markings	in accordance with IEC 60947-1 (VDE 0660 Part 100)
Protection class	IP 40
Contact pieces, connection pieces	fine silver, phosphorous bronze or brass carrier

Spring-return joystick switches for installation diameter 22.3 mm

Switching position, quantity, contacts		Sealing bellows	Connection technology		Flat-pin plugs		See Chart
			Screw terminals	Part number	Ident. number	Part number	
1 NO ●→○←● 1 NO		Silicone, thick-walled	MKTA32/WKT-26	021 6028	MKTAF32/WKT-26	021 6128	A
1 NC ●→○←● 1 NC		Silicone, thick-walled	MKTA32/401/WKT-26	021 6033	MKTAF32/401/WKT-26	021 6133	A
2 NC ●→○←● 2 NO		Silicone, thick-walled	MKTB32/WKT-26	021 6048	MKTBF32/WKT-26	021 6148	B
1 NC/1 NO ●→○←● 1 NC/1 NO		Silicone, thick-walled	MKTB32/1x401/WKT-26	021 6053	MKTBF32/1x401/WKT-26	021 6153	B
2 NO ●→○←● 2 NO		Silicone, thick-walled	MKTC32/WKT-26	021 6068	MKTCF32/WKT-26	021 6168	C
1 NO ●→○←● 1 NO 1 NO		Silicone, thick-walled	MKTC42/WKT-26	021 6073	MKTCF42/WKT-26	021 6173	C
1 NO ●→○←● 1 NO 1 NO		Silicone, thick-walled	MKTC52/WKT-26	021 6078	MKTCF52/WKT-26	021 6178	C
1 NC ●→○←● 1 NC 1 NC		Silicone, thick-walled	MKTC52/2x401/WKT-26	021 6083	MKTCF52/2x401/WKT-26	021 6183	C
4 NO ●→○←● 4 NO		Silicone, thick-walled	MKTE32/WKT-26	021 6203	MKTEF32/WKT-26	021 6303	D
2 NO ●→○←● 2 NO 2 NO		Silicone, thick-walled	MKTE52/WKT-26	021 6207	MKTEF52/WKT-26	021 6307	D
1 NC/1 NO ●→○←● 1 NC/1 NO 2 NO		Silicone, thick-walled	MKTE52/206/WKT-26	021 6213	MKTEF52/206/WKT-26	021 6313	D
1 NC/1 NO ●→○←● 1 NC/1 NO 1 NC/1 NO		Silicone, thick-walled	MKTE52/2x401/WKT-26	021 6218	MKTEF52/2x401/WKT-26	021 6318	D
4 NC ●→○←● 4 NO		Silicone, thick-walled	MKTE32/404/WKT-26	021 6243	—	—	E
4 NC ●→○←● 4 NC		Silicone, thick-walled	MKTE32/800/WKT-26	021 6248	—	—	E
2 NC ●→○←● 2 NO 2 NO		Silicone, thick-walled	MKTE52/206.1/WKT-26	021 6253	—	—	E

○ Position of reset; ●→○←● momentary action position; ● latching position; NO = normally open contact; NC = normally closed contact

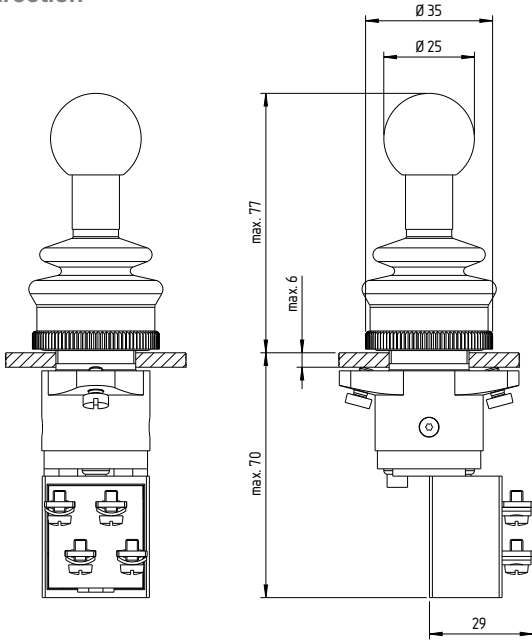
Spring-return joystick switches for installation diameter 30.5 mm

Switching position, quantity, contacts		Sealing bellows	Connection technology		Flat-pin plugs		See Chart
			Screw terminals	Part number	Ident. number	Part number	
1 NO ●→○←● 1 NO		Silicone, thick-walled	WKTA32/WKT-26	0433703	WKTA32/WKT-26	0433803	F
1 NC ●→○←● 1 NC		Silicone, thick-walled	WKT32/401/WKT-26	0433708	WKT32/401/WKT-26	0433808	F
2 NO ●→○←● 2 NO		Silicone, thick-walled	WKTB32/WKT-26	0433723	WKTB32/WKT-26	0433823	G
1 NC/1 NO ●→○←● 1 NC/1 NO		Silicone, thick-walled	WKTB32/1x401/WKT-26	0433728	WKTB32/1x401/WKT-26	0433828	G
2 NO ●→○←● 2 NO		Silicone, thick-walled	WKTC32/WKT-26	0433743	WKTC32/WKT-26	0433843	H
1 NO ●→○←● 1 NO 1 NO		Silicone, thick-walled	WKTC42/WKT-26	0433753	WKTC42/WKT-26	0433853	H
1 NO ●→○←● 1 NO 1 NO		Silicone, thick-walled	WKTC52/WKT-26	0433757	WKTC52/WKT-26	0433857	H
1 NC ●→○←● 1 NC 1 NC		Silicone, thick-walled	WKTC52/2x401/WKT-26	0433763	WKTC52/2x401/WKT-26	0433863	H
4 NO ●→○←● 4 NO		Silicone, thick-walled	WKTE32/WKT-26	0433788	WKTE32/WKT-26	0433888	I
2 NO ●→○←● 2 NO 2 NO		Silicone, thick-walled	WKTE52/WKT-26	0433792	WKTE52/WKT-26	0433892	I
1 NC/1 NO ●→○←● 1 NC/1 NO 2 NO		Silicone, thick-walled	WKTE52/206/WKT-26	0433798	WKTE52/206/WKT-26	0433898	I
1 NC/1 NO ●→○←● 1 NC/1 NO 1 NC/1 NO		Silicone, thick-walled	WKTE52/2x401/WKT-26	0433903	WKTE52/2x401/WKT-26	0434003	I
4 NC ●→○←● 4 NO		Silicone, thick-walled	WKTE32/404/WKT-26	0433928	—	—	J
4 NC ●→○←● 4 NC		Silicone, thick-walled	WKTE32/800/WKT-26	0433933	—	—	J
2 NC ●→○←● 2 NO 2 NO		Silicone, thick-walled	WKTE52/206.1/WKT-26	0433938	—	—	J

○ Position of reset; ●→○←● momentary action position; ● latching position; NO = normally open contact; NC = normally closed contact

A Spring-return joystick switches

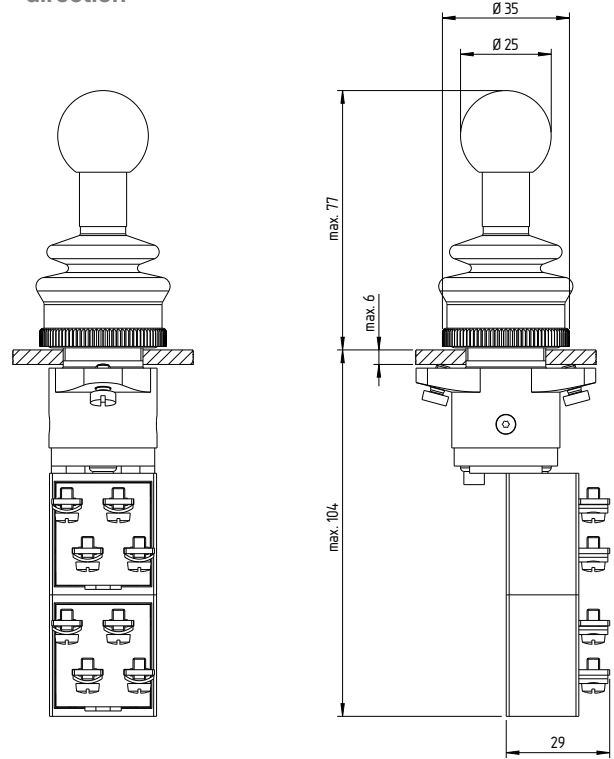
- For installation diameter 22.3 mm
- 2 directions of actuation/1 switching signal for each direction



Not illustrated:
Designs with flat-pin (spade) plug connections (installed width 29 + 1 mm)

B Spring-return joystick switches

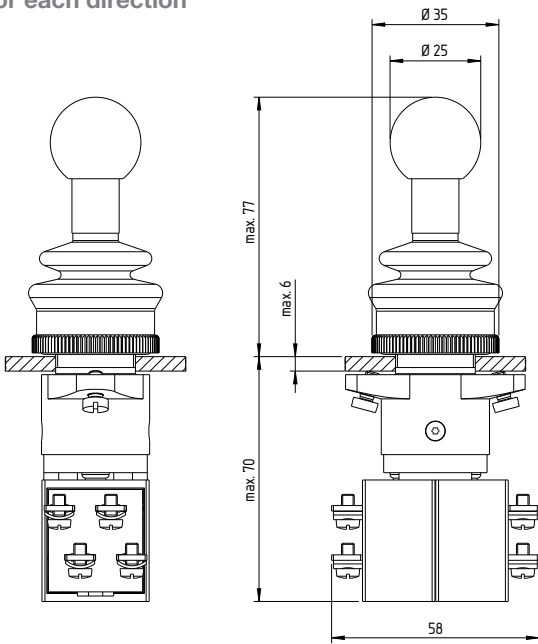
- For installation diameter 22.3 mm
- 2 directions of actuation/2 switching signals for each direction



Not illustrated:
Designs with flat-pin (spade) plug connections (installed width 29 + 1 mm)

C Spring-return joystick switches

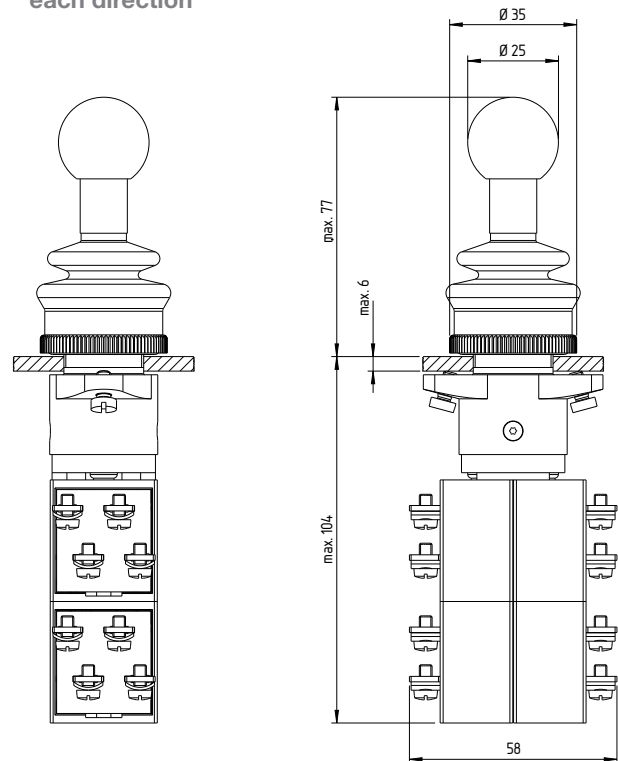
- For installation diameter 22.3 mm
- 2 (3, 4) directions of actuation/2 (1) switching signal(s) for each direction



Not illustrated:
Designs with flat-pin (spade) plug connections (installed width 58 + 2 mm)

D Spring-return joystick switches

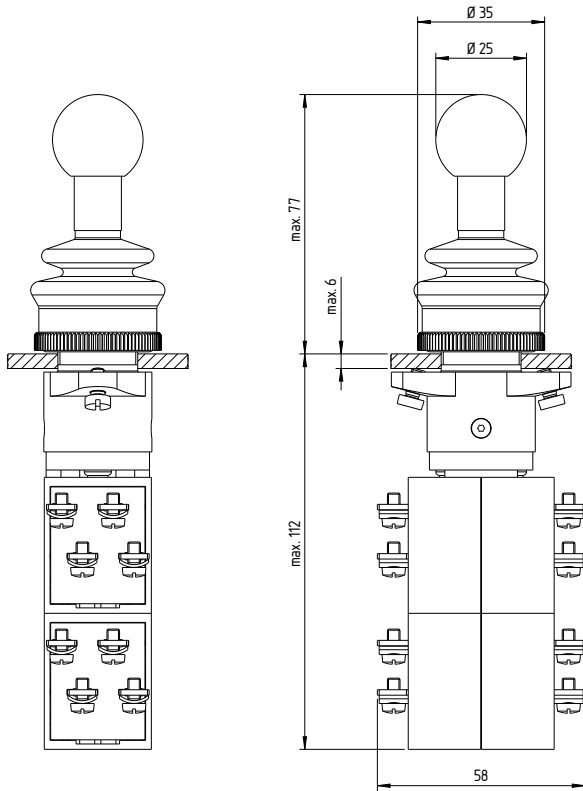
- For installation diameter 22.3 mm
- 2 (4) directions of actuation/4 (2) switching signals for each direction



Not illustrated:
Designs with flat-pin (spade) plug connections (installed width 58 + 2 mm)

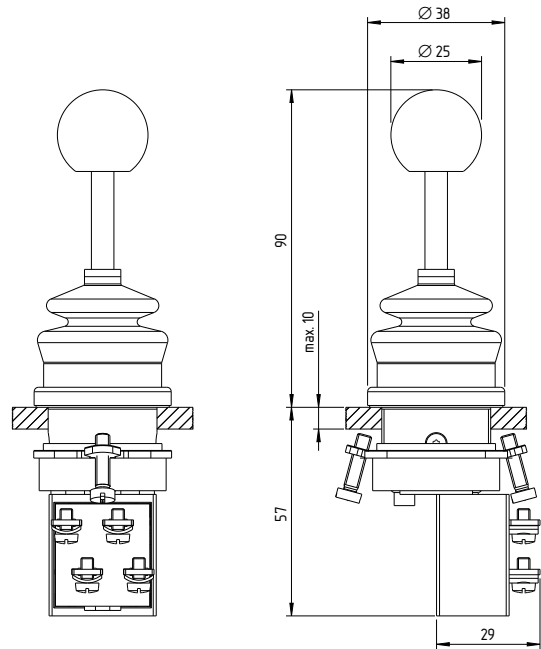
E Spring-return joystick switches

- For installation diameter 22.3 mm
- 2 (4) directions of actuation/4 (2) switching signals for each direction



F Spring-return joystick switches

- For installation diameter 30.5 mm
- 2 directions of actuation/1 switching signal for each direction

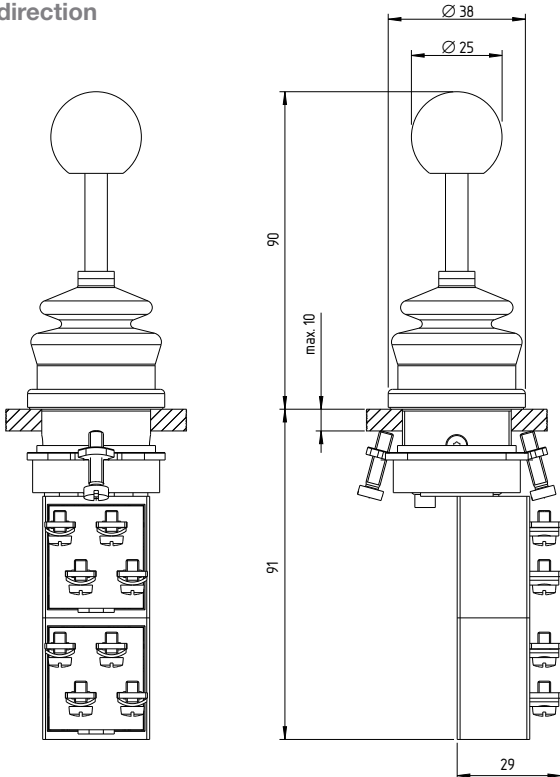


Not illustrated:

Designs with flat-pin (spade) plug connections (installed width 29 + 1 mm)

G Spring-return joystick switches

- For installation diameter 30.5 mm
- 2 directions of actuation/2 switching signals for each direction

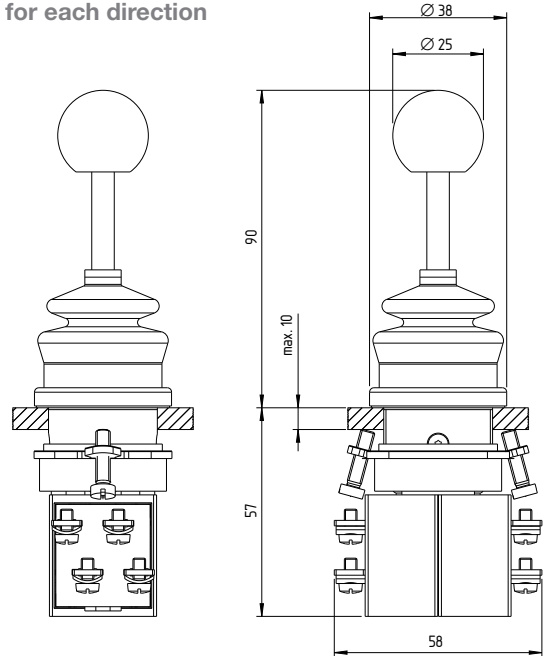


Not illustrated:

Designs with flat-pin plug connections (installed width 29 + 1 mm)

H Spring-return joystick switches

- For installation diameter 30.5 mm
- 2 (3, 4) directions of actuation/2 (1) switching signal(s) for each direction

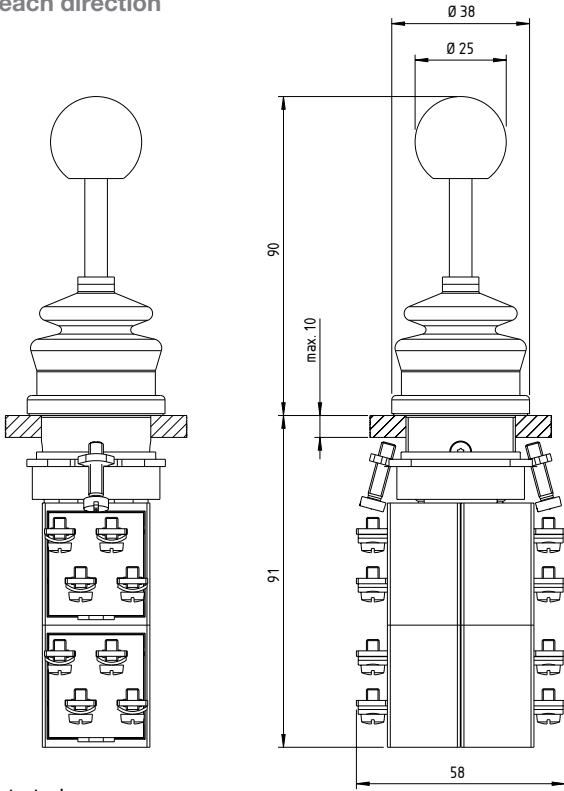


Not illustrated:

Designs with flat-pin plug connections (installed width 58 + 2 mm)

I Spring-return joystick switches

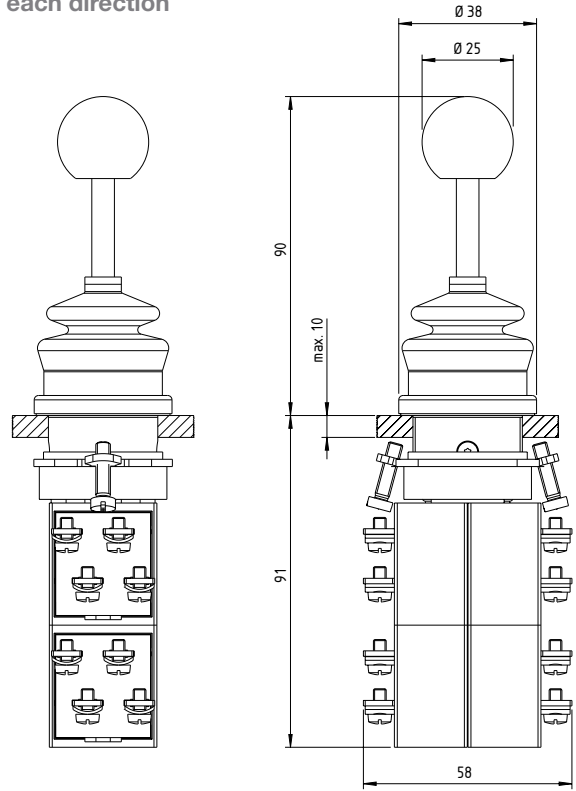
- For installation diameter 30.5 mm
- 2 (4) directions of actuation/4 (2) switching signals for each direction



Not illustrated:
Designs with flat-pin (spade) plug connections (installed width 58 + 2 mm)

J Spring-return joystick switches

- For installation diameter 30.5 mm
- 2 (4) directions of actuation/4 (2) switching signals for each direction



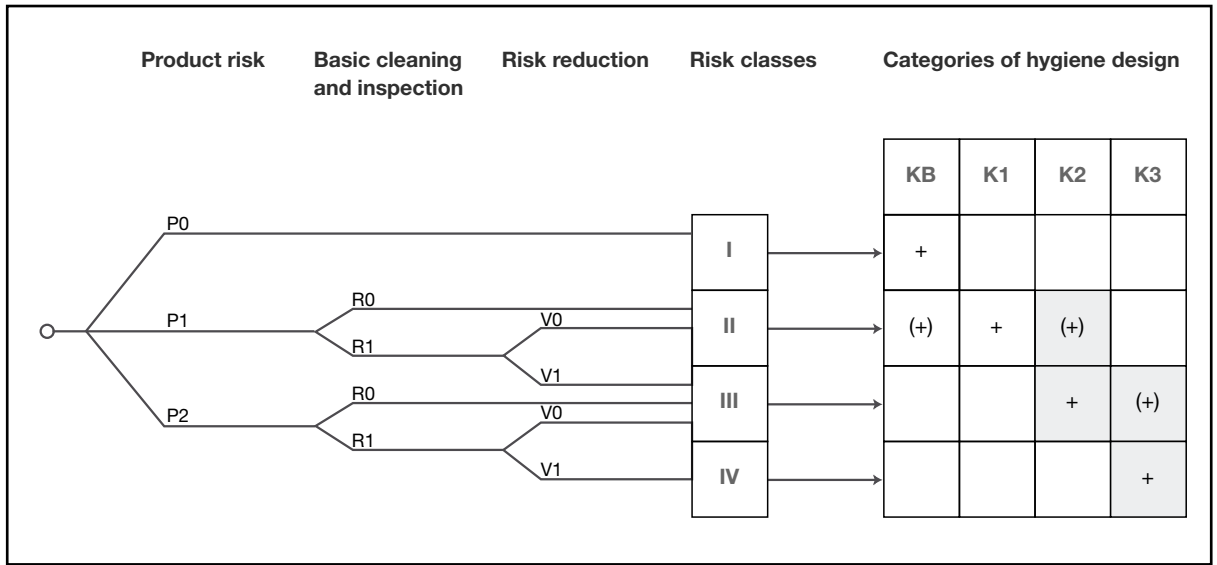
Screw termination only

Additional background information

Appendix 1: Hygienic-conformance design of food processing machines _____	84
Appendix 2: Excerpt from EN 60 204-1 – Electrical equipment of machines: Section 10: operator interface and machine-mounted control devices _____	89

Hygienic-conformance design of food processing machines*

Risk chart showing the hygiene risk in food processing machines



+ = expedient category
(+) = possibly expedient category

- P Product risk**
 - P0 Products with low hygiene-sensitivity
 - P1 Products with moderate hygiene-sensitivity
 - P2 Products with high hygiene-sensitivity
- R Basic cleaning and inspection**
 - R0 Critical points visible and easy to reach
 - R1 Critical points difficult to see and reach
- V Risk reduction**
 - V0 Risk reduction factors present
 - V1 No effective reduction of risk

- K Categories of hygiene design**
 - KB Basic measures
 - K1 Basic measures and application of basic hygiene principles insofar as practicable
 - K2 Basic measures and further application of basic hygiene principles insofar as technologically possible
 - K3 Basic measures and systematic application of basic hygiene principles insofar as technologically possible

Product risk

No primary hygiene risk emanates from a machine. Only a specific product in connection with a machine can lead to a hygiene risk. Machine types of identical design, e.g. mixing machines, may be used for the processing of food or other substances, e.g. plastics. A hygiene risk arises only if these machines are used to process food.

Foods can be divided into those which are more sensitive and those which are less sensitive. It therefore appears to be expedient to use the product as a parameter in determining the basic risk. The hygiene sensitivity will determine the amount of risk on this decision-making level. Hygiene sensitivity will increase proportionate to the perishability of a product and/or the ability to promote pathogenic germs.

The following table shows examples for the assignment of products for the parameters P0, P1 and P2 with indication of classification.

Since a broad range of food processing machines must be considered the classification of a food will depend on the stage of processing.

An example will help explain this: An undamaged egg could be assigned to P0. Once broken a transition is made to P2. After adding flour the dough could be assigned to P1. If the dough is processed into pasta which is then dried then the P0 state will once again be given.

The consideration of product according to processed state will therefore lead to different results depending on the machines used in the different processing levels.

* Source: Handbuch Maschinensicherheit, Ausgabe 1/96, Herausgeber: Berufsgenossenschaft Nahrungsmittel und Gaststätten, Prüf- und Zertifizierungsstelle, Mannheim, ISBN-No. 3-920506-51-0

Assignment of products to the product risk levels (examples)

Possible criteria for product risk assignment:		
P0 (products with low hygiene sensitivity)	P1 (products with moderate hygiene sensitivity)	P2 (products with high hygiene sensitivity)
<p>Products with high salt, sugar, acid, alcohol content, etc.</p> <ul style="list-style-type: none"> - Spirits - Honey - Jam - Chocolate - Sweets - Vinegar - Sauerkraut 	<p>Products which cannot be clearly assigned to P0 or P2, possibly depending on the level of processing</p>	<p>Highly sensitivity products, e.g.</p> <ul style="list-style-type: none"> - Milk - Mayonnaise - Fresh egg - Meat - Delicatessen salads - Fish - Poultry - Ice cream - Cream
<p>Products with low water content, e.g.</p> <ul style="list-style-type: none"> - Cereals - Spices - Tobacco - Flour - Coffee - Snacks 		
<p>Other non-critical products, e.g.</p> <ul style="list-style-type: none"> - Water - Oils 		

Basic cleaning and inspection

Cleaning of an object coming into contact with food is a basic hygiene requirement. This is why it is viewed in the risk chart as a basic factor in addition to the specific product. Cleaning is the basic measure using which the product risk is to be eliminated. However, this applies to a limited extent only if the places which are contaminated by the product are accessible to basic cleaning. Basic cleaning is understood to mean the complete outside cleaning with direct access. This is primarily cleaning by hand or with hand-replacing aids such as water jet, steam jet or cleaning machines. It must be possible to check the result of cleaning by sight.

In this consideration basic cleaning requires that the surfaces coming into contact with the product are easy to access and see. Basic cleaning can therefore only be applied to simple objects or work aids such as troughs, funnels, pots, plates, cutlery, tools.

Complex shapes such as machines and parts of machines are only accessible to basic cleaning if they can be completely dismantled into simple objects with no concealed areas.

Risk reduction

In compliance with EN 1050 risk-reducing circumstances can also be taken into consideration when viewing the hygiene risk.

Risk-reducing circumstances exist if the situation is such as to favourably influence the hygiene risk as resulting from the treatment or processing of the product or from the properties of the product or from the ambient conditions (see above).

Favourable circumstances can be said to exist if, for example, the product is exposed to processes designed to destroy micro-organisms in a machine or to processes that prevent or restrict the growth of micro-organisms.

The risk reduction can also be effective if the process is applied at a later stage of processing in other machines or plants. This means an accumulation of micro-organisms can be accepted if the micro-organisms will be destroyed or their growth prevented at a later stage as long as the creation of toxins does not present a problem.

This consideration primarily applies to the product (consumer protection). In cases in which machine and plant operators are endangered, risk-reducing factors must be given more restrictive consideration. The protection of operators should, however, only be given prime consideration if a risk exists that distinctly exceeds the general risk of life (e.g. in the household).

In this case an individual consideration will be necessary as for all branches in the risk chart.

Risk-reducing factors

Examples of risk reduction			
1. Product processing	2. Measures to extend the life of a product	3. Product properties	4. Ambient conditions
<ul style="list-style-type: none"> - Baking - Boiling - Drying - Acidifying - Pickling - Smoking 	<ul style="list-style-type: none"> - Pasteurization - Microwave radiation - Radioactive radiation - Deep-freezing - Addition of Velcorin - A-septic packaging - Cooking - Fermentation 	<ul style="list-style-type: none"> - Low shelf life - High water solubility (cleaning) 	<ul style="list-style-type: none"> - Cooled machine room - Clean-room conditions

Risk classes

Classification according to the risk chart finally ends in one of several risk classes. It is a measure for the level of risk. Risk class I means a low risk; risk class IV signifies a high risk.

Where several risk classes may be applicable due to alternating products or risk-reducing features applying at different times, classification to the highest class must be made.

Even if in this article the hygiene risk chart has been applied to machines and work aids in the food processing industry, there is nothing to stop it being used for other equipment and machinery (e.g. health service, bio-laboratory, pharmaceutical industry and similar). It is also conceivable for the risk chart to be extended to include higher risk classes in order, for example, to cover the handling of medical instruments, body implants or organs.

It would also be possible to incorporate an HACCP concept [7].

Categories on hygiene design

The risk classes now need to be contrasted with suitable measures of hygiene design. A similar procedure is to be found in EN 954-1 for the control of machines. For the area of hygiene 4 categories (KB, K1, K2, K3) of hygiene design are proposed and contrasted with the risk classes.

The number of categories only incidentally corresponds to the number of risk classes.

These categories can be outlined as follows:

- KB Implementation of basic measures
- K1 Implementation of basic measures and application of basic hygiene principles insofar as this is practicable.
- K2 Implementation of basic measures and further application of basic hygiene principles insofar as this is technologically possible.

K3 Implementation of basic measures and systematic application of basic hygiene principles insofar as this is technologically possible.

Basic hygiene principles in the design of machines are understood to mean the principles mentioned at the beginning.

How can the individual categories now be implemented in practice?

Possible measures for the implementation of designs are shown in the Table "Measures for the hygiene-conform design of parts coming into contact with food" (refer to page 69).

The basic measures provide a foundation expected in every other category. This includes the suitability of materials for food coming into contact with them. As explained in [2] and [6], the selection of a suitable material can be very complex, particularly if no experience exists. In the case of higher risk classes the requirements placed on the choice of material will increase so that the basic measure will be more demanding. The same is true of contact with operating

materials such as lubricants. The description of special cleaning procedures will not usually be necessary in the category KB because cleaning will usually be restricted to basic cleaning.

Special requirements are not placed on surface processing. It is assumed that state of the art material processing used in general mechanical engineering will be sufficient.

Increasingly higher requirements are made in categories K1 to K3 under incorporation of the basic measures. These requirements can be supplemented or replaced by measures which have proved to be more successful in practice if this does better justice to the risk level determined in individual cases.

In principle the bundle of measures will always have to be determined in the individual case. It may well be that a higher or lower category will do better justice to the risk class established. In this case it can or must be used.

Appendix 1

Hygienic-conformance design of food processing machines (continued)

Measures for the hygienic-conformance design of parts coming into contact with food

Proposal for the description of hygiene categories

KB (basic measures)	<ul style="list-style-type: none"> – Use of food-suitable materials – No damaging contact between operating materials and food – Surface roughness of materials as usual in general mechanical engineering
K1	<ul style="list-style-type: none"> – Basic measures – Described cleaning procedure – Harmful grooves and pores reduced – Dead spaces and blind lines accessible for inspection as far as possible – Possible for product and/or cleaning fluid to run off if necessary (possibly in cleaning position) – Surface roughness: $R_z \leq 30$ insofar as technologically possible – Radius of corners and edges: $r > 1.5$ mm
K2	<ul style="list-style-type: none"> – Basic measures – Possibly CIP cleaning – Avoid harmful grooves and pores – Avoid dead spaces and blind lines as far as possible, otherwise easily accessible for inspection – Possibility for product and/or cleaning fluid to run off must be guaranteed (possibly in cleaning position) – Surface roughness: $R_z \leq 25$ (depending on material) – Radius of corners and edges: $r > 2.5$ mm
K3	<ul style="list-style-type: none"> – Basic measures – Contact surfaces made of suitable stainless steel, as far as technologically possible and compatible with basic measures – Possibly CIP cleaning – Possibly sterilization of the machine – Possibly handling of food under a-septic conditions – Possibly one-off use (cycle or batch) of tools or machine parts – Possibly intermediate cleaning at suitable intervals – No harmful grooves and pores – No avoidable dead spaces and blind lines – Possibility for product and/or cleaning fluid to run off must be guaranteed (possibly in cleaning position) – Surface roughness: $R_z \leq 16$ to 25 (depending on application) – Radius of corners and edges: $r \geq 3.2$ to 3.5 mm (depending on application)

The “risk chart for the hygiene risk of food machines” (refer to page 66) therefore also specifies categories in addition to the expedient categories which may also be consulted.

A higher category may also be necessary due to the intended use of the food and/or consumer expectations. High expectations are placed on baby and infant food, for example, by the population and the Federal Act on Contagious Diseases.

Similar expectations may also be placed on other areas of use.

The risk analysis may also not exclude the use of technologies, procedures or materials which have not led to an unacceptable hygiene risk in the past, particularly if they are technologically expedient or necessary.

The advantage of the methods presented is the systematic approach using which an existing material may be assigned to a hygiene risk class.

Suitable measures may be found by the assigned categories of hygiene design.

It is conceivable to assign other category matrices to the risk classes in addition to the categories for hygiene design, e.g. categories for the hygiene-conform conduct of employees or categories of works hygiene.

In the same way a distinction can be made between the food area, splashing area and other areas by different category matrices.

Appendix 1

Hygienic-conformance design of food processing machines (continued)

Literature

- [1] Council Directive on the approximation of the laws of the Member States relating to machinery (89/392/EEC), Official Journal of the EC No. L 183/9-32
Amending directives:
(91/368/EEC, Official Journal of the EC No. L 198/16-32;
(93/44/EEC), Official Journal of the EC No. L 175/12-20
- [2] K. Müller, K. Wickert:
Eignung von Werkstoffen für Nahrungsmittelmaschinen,
ZFL, 45 (1994), No. 10, 58-64
- [3] Safety of Machinery – Principles of Risk Assessment –
EN 1050
- [4] W. Defren: Risikobeurteilung bei Maschinen und Anlagen.
Handbuch Maschinensicherheit, Jedermann-Verlag,
Postfach 103140, 69021 Heidelberg
- [5] Safety of Machinery – Safety-related Parts of Control
Systems, Part 1: General Design Principles– EN 954-1
- [6] K. Müller: Über die Eignung von Werkstoffen für
Nahrungsmittelmaschinen. Handbuch Maschinen-
sicherheit, Jedermann-Verlag, Postfach 103140, 69021
Heidelberg
- [7] HACCP – Grundlagen der produkt- und prozeß-
spezifischen Risikoanalyse, Hrsg. Pierson/Corlett jr.,
Behr's Verlag, Hamburg 1993

Appendix 2

Excerpt from EN 60204-1 – Electrical Equipment of Machines: Section 10: Operator Interface and Machine-mounted Control Devices

10.1 General information

This section contains the requirements placed on equipment mounted outside or partly outside control housings.

Insofar as feasible, this equipment must be selected, mounted and marked or coded in compliance with IEC 73, IEC 447. (A European standard for basic principles for indicators, actuators and marking is in preparation by CENELEC/TK 44X.

10.1.1 Arrangement and mounting

Insofar as feasible, the machine-mounted control devices must satisfy the following requirements:

- they must be easily accessible for operation and maintenance, and
- mounted in such a way that the possibility of damage by handling equipment or by any other moving equipment is minimized.

The actuating organs of hand-operated control devices must be selected and installed such that

- they are easy to reach no less than 0.6 m above the operating level and from the normal position of the operator;
- the operator does not place himself in a dangerous position when he operates them, and
- the possibility of unintentional operation is reduced.

10.1.2 Protection against external influences

In the intended installation the operator interfaces and the machine-mounted control devices must withstand the burdens of normal use and must have a type of protection of at least IP 54, but preferably IP 55 (refer to EN 60529). Together with other suitable measures, the type of protection must provide protection against the following:

- influences of aggressive fluids, vapours or gases, located in the physical environment or used by the machine, and

- the penetration of dirt (e.g. chips, dust, foreign bodies).

10.1.3 Position sensors

Position sensors (e.g. position switches, proximity switches) must be arranged such that they are not damaged when travelled over. Mechanically actuated position switches in current circuits serving safety purposes must be provided with positively opening contacts (refer to EN 60947-5-1).

10.2 Pushbuttons

10.2.1 Colors

Pushbutton actuators must be marked in accordance with Table 2.

The colors of choice for START/ON actuators should be WHITE, GRAY or BLACK, and preferably WHITE. GREEN may be and RED may not be used.

The color RED must be used for emergency stop actuators. The color of STOP/OFF actuators should be BLACK, GRAY or WHITE, and preferably BLACK. RED is similarly permitted. GREEN may not be used.

Table 2: Color marking for pushbutton actuators and their meaning

Color	Meaning	Explanation	Application examples
RED	Emergency	Actuate for dangerous state or in emergency	Emergency stop Initiation of emergency stop functions Refer also to 10.2.1
YELLOW	Non-standard	Actuate in non-standard situations	Action to suppress non-standard state in order to restart an interrupted automatic sequence
GREEN	Safe	Actuate in safe state or to prepare normal state	Refer to 10.2.1
BLUE	Mandatory	Actuate in safe state or to prepare normal state	Reset function
WHITE			START/ON STOP/OFF
GRAY			START/ON STOP/OFF
BLACK			START/ON STOP/OFF (preferred)

N.B.: If additional marking (e.g. structure, shape, position) is used to mark pushbutton actuators, the same colors WHITE, GRAY or BLACK may be used for different functions, e.g. WHITE for START/ON and STOP/OFF actuators.

Appendix 2

Excerpt from EN 60 204-1 – Electrical Equipment of Machines: Section 10: Operator Interface and Machine-mounted Control Devices (continued)

WHITE, GRAY and BLACK are the colors of preference for pushbutton actuators acting alternately as START/ON and STOP/OFF pushbuttons. The colors RED, YELLOW or GREEN may not be used (refer also to 9.2.6).

WHITE, GRAY and BLACK are the colors of preference for pushbutton actuators which initiate an action when depressed and which end the action when released (e.g. inching). The colors RED, YELLOW and GREEN may not be used.

The color GREEN is reserved for those functions which indicate a reliable or normal state.


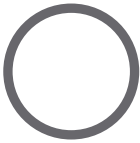


The color YELLOW is reserved for functions which indicate a warning or non-standard state.

The color BLUE is reserved for mandatory functions,

Reset pushbuttons must be BLUE, WHITE, GRAY or BLACK. If they also serve as STOP/OFF pushbuttons, the colors WHITE, GRAY or BLACK are preferred, preferably BLACK. GREEN may not be used.

10.2.2 Marking

In addition to the functional marking described in 18.3, it is recommended to mark pushbuttons with symbols next to, or preferably directly on actuators, e.g.:

START or ON	STOP or OFF	Pushbutton functioning either as START and STOP or ON and OFF	Pushbuttons effecting a movement when actuated and stopping a movement when released (e.g. inching)
417-IEC-5007	417-IEC-5008	417-IEC-5010	417-IEC-5011
			

10.3 Indicator lights and indicators

10.3.1 Types of application
Indicator lights and indicators serve to provide the following information:

- Indication: the operator is to be shown or it is to be indicated that a specific action is to be implemented. The colors RED, YELLOW, GREEN and BLUE are usually used for this type of operation.
- Confirmation: a command, a state or a condition is confirmed, or the end of a change or a transitional period confirmed. The colors BLUE and WHITE are usually used for this type of operation and GREEN may be used in a few cases.

10.3.2 Colors

If nothing has been agreed to the contrary between supplier and operator, the front areas of indicator lights must be marked in color under consideration of the state of the machine in accordance with Table 3. In compliance with IEC 73, different meanings may be assigned in accordance with one of the following criteria:

- the safety of humans and the environment, or
- the state of the electrical equipment.

(Basic indication principles are being prepared by CENELEC/TC 44X.)

Refer to Table on page 73.

10.3.3 Flashing signals

A flashing light may be used as an additional distinguishing feature or to provide additional information and to underline a particular state, e.g. for the following purposes:

- to attract attention
- to bring about immediate action
- to show a difference between target and current state, and

- to show a change in state (flashing during a transitional period).

It is recommended to allocate the higher flashing frequencies to more important information (refer to IEC 73 for recommended flashing frequencies and pulse/pause relationships). (Basic indication principles are being prepared by CENELEC/TC 44X).

10.4 Illuminated pushbuttons

Actuators for illuminated pushbuttons must agree with the meaning of the colors specified in Tables 2 and 3. If there is a difficulty in assigning a suitable color, WHITE must be used. The color effect of RED for the emergency stop actuator may not depend on the illumination.

10.5 Rotary switches

Devices with a rotating part, e.g. rotary potentiometers and selector switches must be attached in such a way that a rotation of the fixed parts is prevented. Friction alone may not suffice.

Table 3: Colors of indicator lights and their meaning with respect to the state of a machine

Color	Meaning	Explanation	Action by the operator	Application examples
RED	Emergency	Dangerous state	Immediate action to react to a hazardous state (e.g. by actuating the emergency stop)	Pressure/temperature outside safe limits Drop in voltage Breakdown Exceeding of a stop position
YELLOW	Non-standard	Non-standard state; critical state immanent	Monitoring and/or intervention (e.g. by restoring the intended function)	Pressure/temperature within normal ranges, authorization to continue
GREEN	Normal	Normal state	Optional	Pressure/temperature within normal ranges, authorization to continue
BLUE	Mandatory	Indication of a state which requires action by the operator	Mandatory action	Order to enter preset values
WHITE	Neutral	Other states; may be assigned if doubt exists as to the use of RED, YELLOW, GREEN or BLUE	Monitor	General information

10.6 Start devices

Actuators used to initiate a start function or the movement of machine parts (e.g. carriages, spindles, drivers) must be constructed and arranged in such a way that unintentional operation is avoided as far as possible. Mushroom buttons may be used for two-hand operation.

10.7 Emergency stop equipment

10.7.1 General

Emergency stop equipment must be present at all operating points and other work stations in which an emergency stop may be necessary (refer also to EN 418).

10.7.2 Versions

Versions of emergency stop equipment include:

- a pushbutton-operated switch
- a pull-wire switch, and
- a foot-pedal switch without mechanical protection.

They must mechanically latch in automatically and be easy to reach.

10.7.3 Functional features

It may not be possible to close the emergency stop circuit before the actuator of the emergency stop device has been reset by hand. If several emergency stop devices are planned the current circuit may not be closed before all previously operated actuators have been reset.

The contacts of manually actuated emergency stop devices must be designed in such a way that they open positively (refer to EN 60947-5-1).

10.7.4 Actuators

Actuators for emergency stop devices must be RED. If there is a background behind the actuator it must be colored YELLOW. The actuator of a pushbutton-actuated switch must be either palm- or mushroom shaped.

10.7.5 Use of shut-off devices

In the case of specific machines for which emergency stop equipment is not viewed to be necessary in accordance with 10.7.2, the main switch may satisfy the function of an emergency stop device (refer to 5.3.3). In these cases and for any such shut-off equipment, as

described in 5.3.2 a), b) and c), the colors must comply with 10.7.4.

10.8 Indicators

Indicators (e.g. optical, including monitor displays; alarm symbols) must be selected and arranged in such a way that they are visible from the usual working position of the operator. If indicators are provided as warning devices the use of flashing and beacon light is recommended which should be accompanied by an acoustic warning device.

(Basic indication principles are being prepared by CENELEC/TC 44X).

NEMA, UL, CSA & IEC INGRESS PROTECTION RATINGS

NEMA, UL, CSA and IEC have each established ratings systems intended to identify an enclosure's ability to repel elements from the outside environment. These rating systems address the enclosure's ability to protect against a variety of environmental conditions. These include:

- Incidental contact
- Rain, sleet and snow
- Windblown dust
- Hosedown and splashing liquids
- Falling dirt
- Oil or coolant spraying/splashing
- Corrosive agents
- Occasional temporary submersion
- Occasional prolonged submersion

While these ratings are intended to help you make a more informed product selection, there are some differences between each organization's system.

As shown in Table 1, the NEMA, UL and CSA ratings most commonly used in North America are based on similar application descriptions and expected performance. However, while UL and CSA require testing in the laboratories (and periodic manufacturer site inspections to ensure continued adherence to prescribed standards), NEMA leaves compliance and certification up to the manufacturer.

While the European IEC (IP) ratings summarized in Table 2 are based on similar test methods, their performance has some slight and subtle differences in interpretation. For example, selected IP ratings permit limited ingress of water, while UL/CSA ratings do not.

For your reference and convenience we have attempted to provide an approximate cross-reference between North American enclosure ratings (NEMA, UL and CSA) and selected IEC (IP) enclosure ratings (Table 3). Please recognize that these are nearest-equivalents only and should not be considered as direct comparisons.

**TABLE 1:
IEC (IP) Enclosure Ratings**

IP	Tests	IP	Tests
0	No protection	0	No protection
1	Protected against solid objects up to 50mm, e.g. accidental touch by hands	1	Protected against vertically falling drops of water, e.g. condensation
2	Protected against solid objects up to 12mm, e.g. fingers	2	Protected against direct sprays of water up to 15° from vertical
3	Protected against solid objects over 2.5mm, e.g. tools and wires	3	Protected against sprays to 60° from vertical
4	Protected against solid objects over 1mm	4	Protected against water sprayed from all directions (limited ingress permitted)
5	Protected against dust (limited ingress, no harmful deposit)	5	Protected against low pressure jets of water from all directions (limited ingress permitted)
6	Totally protected against dust	6	Protected against strong jets of water
		7	Protected against the effects of immersion between 1 cm and 1 m
		8	Protected against the effects of immersion beyond 1 m
		9K**	Protection against high pressure high temperature washdown applications

Example: IP 2 3

Characteristic letters

1st characteristic numeral _____
(Protection against solid objects)

2nd characteristic numeral _____
(Protection against liquids)

An enclosure with this designation is protected against the penetration of solid objects greater than 12mm and against spraying water.

**TABLE 2:
NEMA, UL & CSA vs. IEC (IP) Ingress Protection Ratings***

NEMA, UL, CSA Rating	IEC Rating								
	IP23	IP30	IP32	IP64	IP65	IP66	IP67	IP68	IP69K**
1	●								
2		●							
3				●					
3R			●						
3S				●					
4						●			
4X						●			●
6							●	●	●
6P								●	
12					●				●
13					●				●

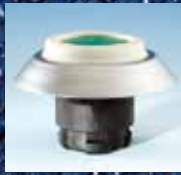
* These are nearest equivalents only, and should not be used to make direct conversions from IEC to NEMA classifications.

** Designed to meet DIN 40050, Part 9 (1983) Protection Type Test.

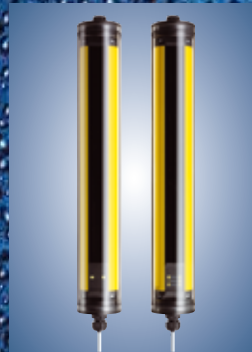
Extreme High-Pressure Washdowns Demand Extreme Seal Controls



Industrial grade IP69K joysticks designed with UV protected bellows



Rugged IP69K control devices for indoor and outdoor use



Type 4 light curtains for use in IP69K washdown environments



Pulse Echo Based SIL3 Safety Sensor meets IP69K



Stainless Steel Coded Magnetic Safety Sensor meets IP69K



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