

**FESTO**

**Expert knowledge and solutions**  
for the food and beverage industry



Expert knowledge and solutions  
for the food and beverage  
industry  
8th edition (formerly 'Manual')

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**Partner to the food and beverage industry >**

Partner throughout the entire production process .....4  
 Food safety .....5  
 Facts for a high overall equipment effectiveness.....6  
 The route to successful energy efficiency.....8

**Directives and standards >**

Organisations.....10  
 Directives and standards for system design.....12  
 Directives and standards for processes and production.....13  
 Other directives and standards in the food and beverage industry .....14  
 About food and beverage production.....15

**Materials and properties >**

Lubricants .....16  
 CRC – Corrosion Resistance Classes .....17  
 Materials.....18  
 Machine design and design requirements.....20  
 Electrical degree of protection .....22  
 Compressed air quality in the food and beverage industry.....25  
 HACCP – Hazard Analysis Critical Control Points.....27  
 The challenge of cleaning – properly and safely! .....29  
 The cleaning process.....30  
 Cleaning and disinfecting agents .....31

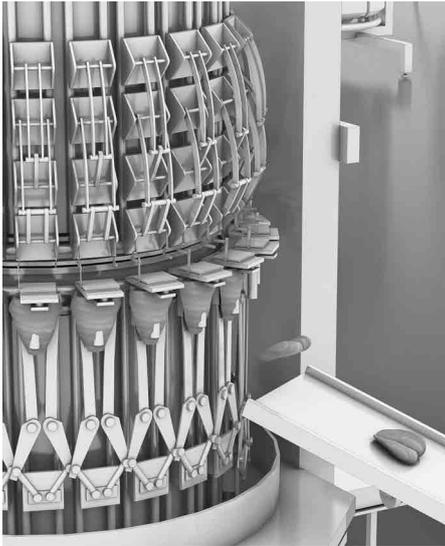
**Products and services >**

Production areas and machine zones.....36  
 Software tools for fast and reliable product selection .....38  
 Selected products and services.....40  
 Ready-to-install solutions .....86  
 Services .....89  
 Festo Didactic.....90  
 What must be taken into account when using Festo products? .....91

## Partner throughout the entire production process

FESTO

1



**Your objective: hygienic and efficient automation**  
**Our solution: partner throughout the entire production process**

Industrial food production must meet the highest standards of hygiene while also being productive. Do the components deliver what the manufacturer promised? Particularly in the food and splash zone, which sometimes have aseptic requirements, this becomes apparent very quickly.

As an experienced partner in the field of automation technology, Festo has the best possible technical expertise and a thorough understanding of all the processes along the value chains of system manufacturers and food producers.

We offer you a complete portfolio of products, systems and selected services for process automation and factory automation.



## Food safety

### Hygienic automation technology in food production

Protecting the consumer and the manufacturer's brand are the key aspects of hygienic and efficient automation in food production. All manufacturers are liable for their products. In the food and beverage

industry, excellent production – especially from a microbiological standpoint – is vital to protect the consumer. It is therefore extremely important that components and systems be hygienic and easy to

clean so that all hazards are taken into account and action is taken to prevent or reduce these hazards.

### Recognising and preventing hazards

Significant hazards in the food zone are caused by:

Biological factors: decay caused by micro-organisms and their toxins  
Chemical factors: cleaning and disinfecting agents and lubricants

Foreign matter: from machines, often produced by corrosion or abrasion, or from other sources

### The basics – standards and directives

Standards and directives form the basis that allows people to safely enjoy food. Implementing these regulations during production

reduces the risks for the manufacturer and the consumer.

→ Chapter "Certificate", page 28

### Selecting the material

In order to protect the food, the machine components must not deposit any substances during the production process that are harmful

to health or that impair the taste or aroma, through either direct or indirect contact with the food.

→ Chapter "Materials", page 18

### Hygienic component design

Resistant surfaces, high surface finish with IP degree of protection and large inside radii enable fast

and efficient cleaning of components and the machine.

→ Chapter "Machine design and design requirements", page 20

### Cleaning

To make certain that the work carried out during the cleaning phase is efficient, the materials used for the machine parts must not react with the cleaning agents or the anti-microbial chemicals (disinfect-

ants). They must therefore be corrosion-resistant and mechanically stable with a finish that prevents the surface from being negatively affected.

→ Chapter "Cleaning and disinfecting agents (generic for typical ingredients)", page 32



## Facts for a high overall equipment effectiveness

1



Maximum availability is not something that happens by chance, but is the result of forward-looking action. The timely processing of dough, vegetables, meat or milk is a must. Otherwise there is a risk of production stoppages and of losing the raw materials to be processed.

What can you do? We recommend three actions:

- Increase machine availability
- Reduce machine downtimes
- Short setup times and fast format changes

All these measures can be implemented right from the very start using Festo products and services. That way, you avoid risks and dissatisfied customers.

### ➔ Note

To ensure a high overall equipment effectiveness, it is essential to choose the right technology and to correctly size the solution.

To facilitate the smooth operation of your systems, we offer support in service, maintenance and optimisation.

## 1. Increasing machine availability

### Avoiding downtimes

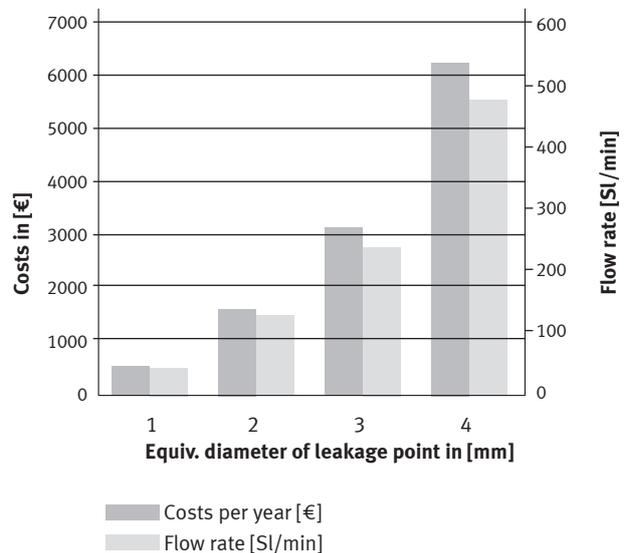
#### Condition monitoring as an early-warning system

With SFAM flow sensors, for example, you can detect leakages in your system by comparing the setpoint and actual values. These are not only indicators of increased wear and, consequently, potential unplanned downtimes, but also of unnecessary energy expenditure. By implementing this measure together with condition-based maintenance, you quite simply save a lot of money (see figure). In addition, the differential pressure indicator for the fine and micro filters (LFM-B and -A of service units, type MS) shows the filter saturation.

### Correct component selection

Components that have been optimally tailored to the application are an ideal way of increasing machine availability. Use the expertise of our specialists and our engineering tools when choosing the right solution. The tube selection of Festo Engineering Tools, for example, will guarantee that you always use the right tube. Please note: using the wrong tube material can lead to early wear and unexpected machine failure.

### Machine availability and energy efficiency



### Extending maintenance intervals

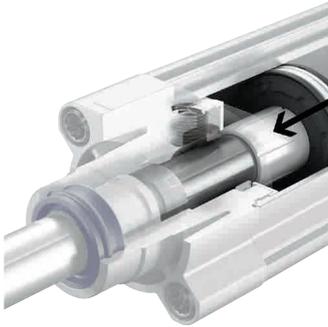
Suitable components are those with an extremely long service life. The unlubricated seal, for example, when used with cylinders CRDSNU, DSBF and DGRF, helps to reduce wear, even if the piston rod runs dry when used in washdown environments.

### Creating optimum operating conditions

Having reliable information at a glance, such as the ability to check operating conditions easily, e.g. with a red/green pressure gauge, enables immediate detection of overloads and other wearing factors. And good air preparation,

e.g. with service units type MS, increases the service life of valves or actuators.

## 2. Reducing machine downtimes



### Fast detection of faults

Diagnostics, such as those that can be carried out with the error memory of the modular electrical

### Quick and easy remediation of faults

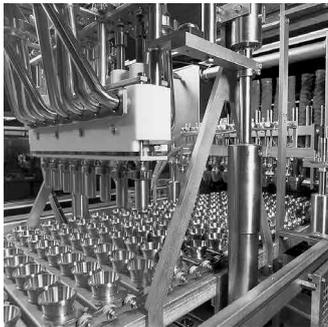
Low-maintenance components and systems save time and effort. Cylinders like CRDSNU in Clean Design with self-adjusting cushioning PPS can be used immediately without the need for adjustment. Exchanging components without losing time is possible if they are hot-swap enabled; this allows them to be changed over during operation. For example, these properties can be found in our valve terminals VTSA and MPA.

terminal CPX, considerably reduce the effort required to find the fault thanks to the immediate display of the type and location of the fault.

### Fast availability of spare parts

You can rely on our innovative products, solutions and services being available around the clock and around the globe. Our technical hotlines, spare parts and repair services, 24-hour emergency service and on-site after-sales service are just some examples of how we do this. With over 250 branch offices in 176 countries and national companies in 61 countries, we are always in close proximity to you. So you can benefit from close cooperation and worldwide availability.

## 3. Short setup times and fast format changes



### High degree of flexibility

Automatic format adjustments – made possible for instance, by the servo motor MTR-DCI with integrated controller and 16 programmable positions – can save you a lot of time. This is particularly important if your production has to be highly

flexible with frequent product and format changes.

With the electric cylinder EPCO in the Optimised Motion Series (OMS), you can cost-effectively retrofit existing systems to achieve a high degree of flexibility.

For simpler functions, our pneumatic multi-position cylinder is also

suitable as an alternative to electric drives.

Different profiles can often be a major challenge for volumetric filling. The electric cylinders ESBF, make any change to e.g. quantity, viscosity etc., very simple as the profiles are stored during programming.

### TPM:

Total Productive Maintenance

TPM is a program for the continuous improvement of systems and machines.

The aim is to increase efficiency to a maximum. Losses, quality deficiencies and waste are identified, analysed and remedied.

One of the most important reference data is Overall Equipment Effectiveness, or OEE for short.

### OEE:

Overall Equipment Effectiveness

Overall Equipment Effectiveness is a measure of the added value of equipment.

The Overall Equipment Effectiveness is the product of the three factors availability, performance and quality. The efficiency is indicated with values of between 0 and 1 or 0% and 100%.

### TCO:

Total Cost of Ownership

With the Total Cost of Ownership, all costs such as procurement costs and running costs (energy costs, repair and maintenance) are taken into consideration for the calculation.

Possible cost drivers or even hidden costs can thus be identified at an early stage.

Components or systems that are initially cheaper can lead to considerably higher costs over the course of their service life compared to components and systems that are allegedly more expensive.

### Maintenance:

- Corrective maintenance: components are repaired or replaced after a failure. This type of maintenance is reactive and cannot be planned.
- Preventive maintenance: replacement of components after a specific interval. These components can still be operational; however, any failure usually leads to high costs.
- Condition-based maintenance: the condition of components is monitored and thus known at all times. Maintenance takes place in a planned and forward-looking manner and only as required.

## The road to successful energy efficiency

**Sustainable energy efficiency in automation demands a sophisticated concept that encompasses four different areas:**

- Intelligent design
- Energy-efficient products and solutions
- Services
- Training and consulting

Each of these four areas contributes to an increase in energy efficiency, regardless of the area that is first chosen on the way to energy efficiency. For optimum energy efficiency which meets the current standards or, looking forward, even surpasses them, it is recommended to use all four areas in combination.

Festo's perfectly coordinated concept takes into account all the essential points of the value creation chain of our customers, from the initial design considerations and energy-efficient engineering systems up to the after-sales process. Training courses ensure that the required efficiency can be sustained beyond the first day, as they go further than mere product knowledge during design and purchasing; they communicate guidelines for construction, the identification of weak points and the maintenance of energy-efficient systems.

The Energy Saving Services also make a great contribution to energy-efficient systems – and provide concrete optimisation approaches. Once implemented, the operator can save up to 60% on energy costs - in most cases, the ROI takes just one year. Intelligent engineering with intelligent and innovative selection software assist you in designing your systems. This allows you to use smaller components and avoid the accumulation of safety factors.

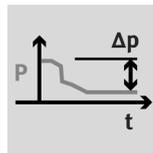
### Services

#### Products and solutions

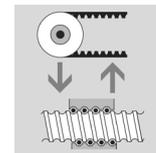
##### Energy efficiency measures



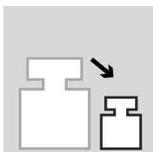
Reducing pressure level



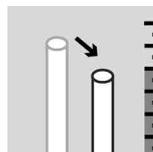
Reducing pressure drops



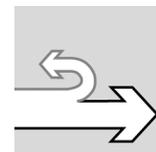
Choosing the right components



Reducing weight



Reducing tube lengths

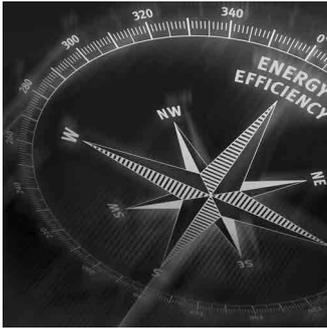


Recovering energy

#### Configuration and optimisation

#### Training and consulting

## The route to successful energy efficiency



### Products and solutions

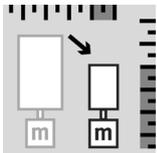
Festo offers its customers energy-efficient products and solutions! Astonishing savings potential can now be achieved with electrical and pneumatic components and solutions from Festo, from highly efficient compressed air preparation to the valve/valve terminal level and the front unit. Impressive as a stand-alone solution – almost unbeatable when combined.

### Services

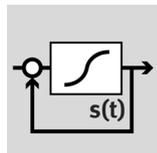
Festo Energy Saving Services offer users of compressed air a tailored range of services for identifying and exploiting potential for compressed air savings. The service package for consistent and lasting energy savings is of interest for all users of compressed air.

### Training and consulting

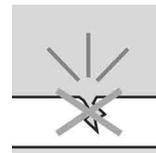
Benefit from the synergies created through Festo Didactic's close links with industry and its training expertise



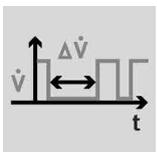
Correct dimensioning



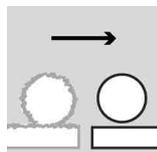
Efficient open- and closed-loop control



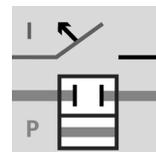
Reducing leaks



Using air-saving circuits



Reducing friction



Turning off energy

## Organisations



**ISO:**  
**International Organization for Standardization**

The International Organization for Standardization develops international standards in all fields with the exception of electrical engineering and electronics, for which the International Electrotechnical Commission (IEC) is responsible,

and with the exception of telecommunications, for which the International Telecommunication Union (ITU) is responsible. Together, these three organisations make up the WSC (World Standards Cooperation).



**UL:**  
**Underwriters Laboratories**

UL was founded in 1894 and is an independent organisation that tests and certifies products in terms of their safety. UL does not actually "approve" products, but rather the organisation tests products, components, materials and systems to make sure they meet the specific standards. If they do fulfil the standards, they are permitted to carry the fee-based UL mark of

conformity for as long as they adhere to the prescribed standards. UL has developed more than 1300 safety standards, which include many American National Standards (ANSI). A typical standard for electrical articles not only includes requirements for electrical safety, but also a wide spectrum with respect to flammability and mechanical sources of hazards.



**CE:**  
**Communauté Européenne**

With the CE marking, the manufacturer or authorised EU representative states that "the product meets the applicable requirements stipulated in the Community harmonisation legislation" in accordance with EU Directive 765/2008. The CE marking is not a (test) "seal", but an administrative

symbol enabling the free movement of correspondingly labelled products within the European market. The marking consists of the CE logo, (if required) in combination with the four-digit code number of the relevant Notified Body, if this body was involved in performing the conformity test.



**ATEX:**  
**ATmosphère EXplosibles**

ATEX approval certificates refer to two guidelines from the area of explosion prevention and protection.

- ATEX Product Directive 94/9/EC
- ATEX Operational Directive 1999/92/EC

Equipment from a certain ATEX category may only be used in certain zones, i.e. equipment in category 2 may be used in zones 1 and 2 for gases or vapours and in zones 21, 22 for dust.

Gases and vapours are classified into the three explosion groups, IIA, IIB and IIC, on the basis of their particular flammability. The hazardousness thereby increases from explosion group IIA to IIC. The higher explosion groups encompass the lower group(s).

Dusts are classified into the groups IIA (combustible lint), IIIB (non-conductive dusts) and IIIC (conductive dusts).

## Organisations



U.S. Food and Drug Administration

**FDA:**  
**Food and Drug Administration**

This US authority is responsible for granting approval for the manufacture and marketing of food, cosmetics and pharmaceutical products in the United States. The quality of the final product is always the primary focus. The production process and system design are given equal consideration.

The CFR (Code of Federal Regulations) published by the FDA, in particular 21CFR 170 ff, is an important reference work that includes a list of approved construction materials.

→ <http://www.fda.gov>



**EHEDG:**  
**European Hygienic Engineering & Design Group EHEDG (Festo is a member)**

The European Hygienic Engineering & Design Group is a consortium of research institutes, food producers, equipment manufacturers and public health authorities. It was founded in 1989 with the aim of promoting hygienic engineering and design. The aim is to ensure safe food processing and packaging. The consortium actively supports European legislation and works with the NSF and 3-A in the United States to harmonise standards and directives.

Handling, preparation, processing and packaging of food must be carried out hygienically. This should be achieved through hygienic machinery and hygienic premises in accordance with EC Machinery Directive 2006/42/EC and in compliance with the hygiene requirements of European standards EN 1672-2 and ISO 14159.

→ <http://www.ehedg.org>



**NSF International**

NSF International, a non-profit US organisation, is the world leader in standards development, product certification, knowledge transfer and risk management in accordance with the relevant health and environmental protection standards.

Specialising in food, water, air and the environment, NSF develops national guidelines (USA), runs training courses and offers auditing services on a third-party basis to review compliance with the relevant health and environmental protection standards.

→ <http://www.nsf.org>



**3-A:**  
**Sanitary Standards**

3-A was established by manufacturers of dairy and ice-cream production equipment and distributors of dairy products. The organisation develops design standards for easy-to-clean food production machinery, especially dairy equipment, in the USA.

Observing 3-A standards is important for companies that want to market their products in the USA or Japan. End users demand 3-A conformity for reasons of quality, hygiene, faster cleaning times and the associated minimal downtimes.

→ <http://www.3-a.org>

## Directives and standards for system design

<b>Not all standards are the same</b>	Standards differ not only with regard to subject matter, but also in terms of the importance attributed to the content.	Thus the Machinery Directive 2006/42/EC is as the primary point of reference, while the other standards provide detailed information on hygiene aspects of machine design and safety of food production systems.	Incidentally, EU directives are binding for all member countries and must be transposed into national law.
<b>EC Machinery Directive 2006/42/EC Specifications for cleaning</b>	This directive focuses on health and safety requirements put in place to protect operating personnel of various machine types.	Possible risks should be eliminated. Special hygiene requirements apply to machinery intended for the preparation and handling of food.	Machines must be designed and built in such a way that any risk of infection, sickness or contagion is avoided. It forms the basis for the CE conformity system.
<b>ISO 14159</b>	Hygiene requirements for machinery design	Machines can present hygiene risks that, if passed on to food products, could endanger the final consumer.	All machine builders must therefore adhere to risk prevention requirements and provide food producers with operating instructions for their machines and systems.
<b>EN 1672-1</b>	Food processing machinery – Basic Concepts, Part 1	This standard provides comprehensive information on safety requirements for the operators of food processing machinery.	
<b>EN 1672-2</b>	Food processing machinery – Basic Concepts, Part 2	These standards provide guidelines for the hygienic design of food processing machinery.	They also provide general information on the special requirements for construction materials.
<b>ISO 13849-1</b>	Safety of machinery – Safety-related parts of control systems – Part 1: General Principles for Design (ISO 13849-1)	The standards ISO 13849-1 and -2 will completely replace EN 954-1 after 31.12.2011. They describe the risk reduction required during the design, construction and integration of safety-related parts of control systems and protective devices, regardless of whether these parts are electrical, electronic, hydraulic, pneumatic or mechanical.	Example: MS6-SV
<b>EHEDG doc 8</b>	Criteria for the hygienic design of machinery, equipment and components	This document describes the criteria for the hygienic design of equipment intended for processing of food.	It was first published in 1993 and describes in more detail the requirements of the Machinery Directive (98/37/EC ref.1). Since then, parts of it have been included in the standards EN 1672-2 and ISO 14159.

## Directives and standards for processes and production

### Regulation on food hygiene 852/2004 , 853/2004, 854/2004

This directive replaces Directive 93/43/EEC on the hygiene of food. Its aim is the creation of a comprehensive, integrated policy for all food products that extends from agricultural production to the sale to the consumer. Food hygiene must be guaranteed at all stages of production, from primary production to the sale to the end consumer.

Food businesses apply the principles of the HACCP system. The HACCP system is an instrument that helps food businesses to achieve higher standards in food safety. It is not a means of self-regulation and does not replace official controls.

Other EU directives on hygiene: EC Directive 853/2004, which lays down specific hygiene rules for food of animal origin  
EC Directive 854/2004, which lays down specific rules for the organisation of official controls on products of animal origin intended for human consumption.

### HACCP Hazard Analysis Critical Control Points

In the 1960s, NASA developed a programme (ZDP: Zero Defects Program) to guarantee a safe food supply for astronauts. This program was based on risk analyses and error prevention strategies used in the automotive and pharmaceutical industries.

#### Transfer of confidence

A comprehensive description of the HACCP concept was published in the USA in 1971. A committee realised that this concept would increase consumer confidence if applied to the food industry. A document on the application of the HACCP concept in food production processes was therefore drafted. The EU Directive on Food Hygiene was published in 1993, introducing the HACCP concept in Europe.

#### Individual responsibility

HACCP systems force companies to assume responsibility for ensuring the safety of food products. Every manufacturer involved in the food industry in the European Union must ensure the quality of its food products and the prevention of any health risks to consumers.

#### Process control

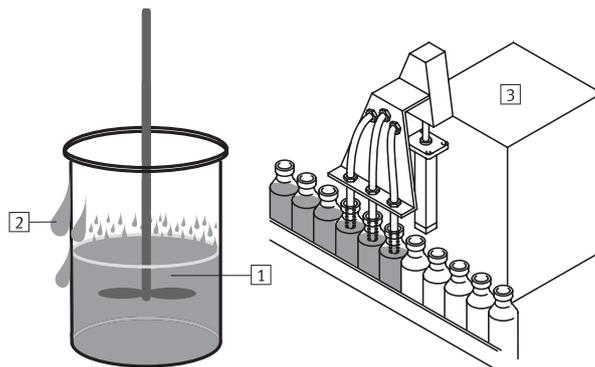
HACCP is a systematic process for the identification, evaluation and prevention of risks and hazards. The objective of the concept is to reduce increased hygiene risks in food products through continuous, integrated process controls.  
→ Chapter "HACCP – Hazard Analysis Critical Control Points", page 27

## Other directives and standards in the food and beverage industry

DIN 10516	Draft Standard on Cleaning and Disinfection	This draft provides support in the selection and implementation of suitable measures for cleaning and disinfecting systems and equipment used in the food industry.
DIN 11483 ("withdrawn" without replacement)	Cleaning and Disinfection of Dairy Equipment	Recommendations for the cleaning process as well as information on suitable disinfecting and cleaning agents for stainless steel machinery and equipment used in the food industry.
1935/2004/EC	Directive on materials and articles intended to come into contact with food	
10/2011	Regulation 2002/72 was replaced by EU directive no. 10/2011 dated 14 January 2011 on plastic materials and items that are intended to come into contact with food. → <a href="http://eur-lex.europa.eu/">http://eur-lex.europa.eu/</a>	This directive is applicable in all member states and is aimed at maintaining a high pace of innovation. If a directive were to amend the lists of monomers and additives in order to authorise new substances, this would delay transposition by more than 12 months.
ISO 21469	Specifies hygiene requirements for the formulation, manufacture and use of H1 lubricants. Safety of machines – lubricants with incidental product contact – hygiene requirements (ISO 21469:2006).	

## About food and beverage production

EN 1672-2  
ISO 14159



The European standard EN 1672-2, which defines hygiene requirements for food processing machinery, specifies three zones for the industry:

### 1 Food zone

The food zone includes all system parts and components that come into contact with food, i.e. the component is mounted directly within the food flow or food comes into contact with the component before being returned to the product flow.

Parts that come into contact with food must be easy to clean and disinfect. They must also be corrosion-resistant, non-toxic, non-absorbent, smooth and of one-piece construction or sealed in order to prevent food particles collecting in small gaps. Parts that are difficult to

remove pose a contamination hazard. In addition, only special food-compatible lubricants may be used. These requirements also apply to parts that are dismantled for cleaning.

### 2 Splash zone

Machine parts and components in the splash zone come into direct contact with food. The food cannot be returned to the product flow from this zone.

However, the splash zone should still be planned and designed according to the same criteria as the food zone, even if the product cannot be returned to the food process.

The technical implementation can often be less stringent, provided this does not have an unfavourable effect on the quality of the production process.

### 3 Non-food zone

The components do not come into contact with the food. Nevertheless, all the parts and system components used in the non-food zone should be made from corrosion-resistant materials and be easy to clean and disinfect.

Otherwise, sources of infection could arise in the long term.

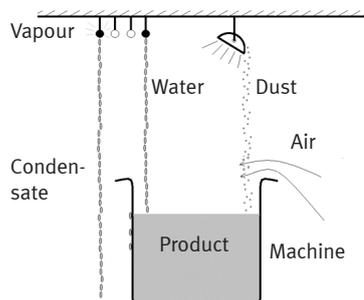
EHEDG



The EHEDG (Doc. 8) and ISO 14159 basically only differentiate between "surfaces that come into contact with products" and "surfaces that do not come into contact with products". With respect to surfaces that come into contact with products, the same requirements apply in accordance with EN 1672-2 – Food Zone.

#### ➔ Note

EHEDG additionally takes into account the possibility of surfaces contaminated, e.g. by dusts, condensate, etc. and defines these as surfaces that come into contact with products.



## Lubricants



The USA has the strictest regulations worldwide on the use of lubricants and additives in the food industry.

Lubricating greases and oils must comply with FDA regulations, especially section 21 CFR 178.3570. This section specifies which substances may be present in lubricat-

ing greases and oils that come into contact with food or their ingredients, regardless of whether they are used as protective agents (for example as a rust prevention layer), as releasing agents for seals and sealing rings in container closures or as lubricants for machine parts and fixtures.

Thus the approvals issued by the American National Sanitation Foundation (NSF) are universally regarded as standards for the composition of base materials and additives for lubricants (ISO 21469).

## NSF-H1:

Contact between food and lubricants may be unavoidable within the production process. Only lubricants that have been granted NSF-H1 approval may be used in such cases.

## Examples:

The following products from Festo are lubricated with NSF-H1 approved grease:

- Standard cylinders CRDSNU, CRDNG, guided drive DGRF, standard cylinder DSBF, compact cylinder CDC, round cylinder CRHD, push-in fitting NPQH, one-way flow control valve GRLA-F

## → Tip

To avoid any mix-up, only use NSF-H1

## NSF-H2:

These lubricants are suitable for general use in the food industry, although contact with food must be ruled out.

In practice, the introduction of HACCP systems in food production facilities necessitates greater examination of all lubricants within the production process in order to avoid the potential risk of food contamination.

## NSF-H3:

These are soluble oils, which are used for cleaning or for corrosion protection for machinery.

These lubricants are **not** suitable for use in the food industry

## → Note

Risk of confusion!  
NSF-H3 and NSF-3H are not the same.

## NSF-3H:

Releasing agents with direct contact with food.

## CRC – Corrosion Resistance Classes

### Corrosion resistance as a quality factor

In an industry where intensive cleaning is required, such as the food and beverage industry, corrosion resistance is a major issue.

This is hardly surprising given that the service life and ease of cleaning of components are closely linked

and together create a significant cost factor.

### What do the CRC classes mean?

The CRC designation represents corrosion resistance classes. These classes are defined in the Festo standard FN 940070. To define the CRC class of a product, the product must undergo four different tests:

1. W/K:  
Heat/cold rating  
(+120 °C /-20 °C)
2. KFW:  
Condensed water in a changing climate DIN 50017-KFW
3. SO2:  
Kesternich test to  
DIN EN ISO 6988 KFW 0.2S
4. SS:  
Salt spray test with NaCl  
solution (5%) to DIN 50021-SS

The CRC classes range from 0 up to the maximum level of 4. A specific number of cycles (one cycle = 24-hour test) must be completed for each test. The results are used to classify the product in a CRC matrix, thus defining its CRC class.

Corrosion Resistance Class CRC		Comment
0	Corrosion resistance class	<ul style="list-style-type: none"> <li>– For small, visually irrelevant standard parts e.g. threaded pins, circlips, clamping sleeves, etc.: phosphated or burnished versions (oiled if necessary) as well as ball bearings (for components &lt; CRC3) and plain bearings</li> </ul>
1		<ul style="list-style-type: none"> <li>– Dry internal use or transport and storage protection</li> <li>– Parts that do not have primarily decorative surface requirements, e.g. in internal areas that are not visible or behind covers.</li> </ul>
2		<ul style="list-style-type: none"> <li>– External, visible parts with primarily decorative surface requirements</li> <li>– Direct contact with a normal industrial environment or media, such as coolants and lubricants</li> <li>– Internal application in which corrosion can occur</li> </ul>
3		<ul style="list-style-type: none"> <li>– External, visible parts which are in direct contact with a normal industrial environment or media, such as solvents and cleaning agents</li> <li>– Primarily functional surface requirements</li> <li>– Outdoor exposure under moderate corrosive conditions</li> </ul>
4		<ul style="list-style-type: none"> <li>– Parts used with aggressive media, e.g. in the food or chemical industry</li> <li>– Outdoor exposure under severe corrosive conditions</li> </ul> <p>These applications should be supported with special tests with the media if required (cleaning and disinfecting agents) (FN 940082 standard from Festo).</p>

## Materials

### Selecting the material

In order to protect the food, the machine components must not deposit or take in any substances during the production process that are harmful to health or that impair the taste or aroma, through either

direct or indirect contact with the food. To make certain that the work carried out during the cleaning phase is safe, the materials used for the machine parts must not react with the cleaning agents or the

anti-microbial chemicals (disinfectants). They must therefore be corrosion-resistant and mechanically stable with a finish that prevents the surface from being negatively affected.

### Standard materials in the food industry

#### High-alloy stainless steel

High-alloy stainless steel is usually the logical choice of material for the construction of machines and units in the food industry.

#### High-alloy steels (RoHS-compliant)

AISI	EN10088-1	DIN	International	Suitable for contact with food products in accordance with	Corrosion Resistance Class CRC
AISI 304	X5CrNi18-10	1.4301	0Cr18Ni9 (China) SUS 304 (Japan) STS 304 (Korea) 08Ch18N10 (GUS)	ANSI/NSF 51	3 (4 with smooth surface, by electro-polishing for example)
AISI 316	X5CrNiMo17-12-2	1.4401	STS 316 (Korea) 08Ch16N11M3 (GUS) 0Cr17Ni12Mo2 (China) SUS 316 (Japan)	ANSI/NSF 51	3 (4 with smooth surface, by electro-polishing for example)
AISI 316L	X2CrNiMo17-12-2	1.4404	00Cr17Ni14Mo2 (China) STS 316L (Korea) SUS 316L (Japan)	ANSI/NSF 51	3 (4 with smooth surface, by electro-polishing for example)
AISI 316L	X2CrNiMo18-14-3	1.4435	00Cr17Ni14Mo2 (China) SUS 316L (Japan)	ANSI/NSF 51	3 (4 with smooth surface, by electro-polishing for example)
AISI 329	X3CrNiMoN27-5-2	1.4460	0Cr26Ni5Mo2 (China) 10Ch26N5M (GUS) SUS 329J1 (Japan)	ANSI/NSF 51	3 (4 with smooth surface, by electro-polishing for example)
AISI 316Ti	X6CrNiMoTi17-12-2	1.4571	0Cr18Ni12MoTi (China) 10Ch17N13M2T (GUS) STS 316Ti (Korea) SUS 316Ti (Japan)	ANSI/NSF 51	Titan increases the CRC to 4

### Aluminium

Aluminium materials are frequently used. It is affordable and easy to work with and process.

#### Aluminium alloys (RoHS-compliant)

Designation	Material number in accordance with EN	Suitable for contact with food products in accordance with	Corrosion Resistance Class CRC untreated	Corrosion Resistance Class CRC anodised
AlCuMg1, AlCuMg2	EN AW-2017A, EN AW-2024	–	0	1
Al99,5	EN-AW-1050A	ANSI/NSF 51	0 ... 1	2
AlMgSi0,5	EN-AW-6060	ANSI/NSF 51	1 ... 2	3
AlMgSi0,7	EN-AW-6005A	ANSI/NSF 51	1 ... 2	3
AlMgSil	EN-AW-6082	ANSI/NSF 51	1 ... 2	3
AlMg1, AlMg3, AlMg5	EN-AW-5005, EN-AW-5774, EN-AW-5019	ANSI/NSF 51	1 ... 2	3

## Materials

### Plastics

Plastics and elastomers permitted to come into direct contact with food must comply with Directive 1935/2004/EC or the Plastics Directive 10/2011 or the directives of the FDA.

In addition to resistance to stress, ease of cleaning is also an important factor in the selection of suitable plastic materials. They must not give off or absorb any hazardous substances.

#### → Note

The plastics listed are found in the food industry. A plastic from a group (e.g. PP) that is compliant with directives must always be checked on an individual basis to ensure conformity. A group of plastics is **never** inherently compliant.

Plastics and elastomers				
Designation	Code	Conformity within the group possible based on:	Resistant to diluted acids	Resistant to diluted lyes
Polypropylene	PP	FDA and/or 10/2011	±	+
Polyamide	PA	FDA and/or 10/2011	–	0
Polyvinyl chloride	PVC	–	±	±
Polyvinylidene fluoride	PVDF	FDA and/or 10/2011	±	±
Polyoxymethylene	POM	FDA and/or 10/2011	–	0
Polymethyl methacrylate	PMMA	FDA and/or 10/2011	±	±
Polycarbonate	PC	FDA and/or 10/2011	±	–
HD-polyethylene	PE-HD	FDA and/or 10/2011	±	±
Polyethylene terephthalate	PET	FDA and/or 10/2011	0	–
Polyether ether ketone	PEEK	FDA and/or 10/2011	±	±
Polytetrafluoroethylene	PTFE	FDA and/or 10/2011	±	±
Ethylene propylene diene terpolymer	EPDM	FDA	±	±
Fluoro elastomer	FKM/FPM	FDA	±	–

–: Not resistant; 0: Resistant to a limited extent; ±:Resistant

A comprehensive overview of the resistance of plastics and elastomers to acids, lyes and other substances can be found on the Festo homepage:

→ [www.festo.com/media\\_resistance](http://www.festo.com/media_resistance)

#### → Note

Festo products are not made of materials for contact with food. If permanent contact with food is planned, an individual test must be carried out in consultation with Festo.

The above-named plastics and elastomers are used in Festo products. To some extent, the materials used are compliant with FDA directives and/or the Directive 10/2011 EC. More information on this point can be found in the certificates for our products. For example, in the products NPQP, NPQH, CRDSNU, among others, components made from the above mentioned plastics and elastomers are used.

**The correct selection of a suitable plastic involves many parameters that are based on their design, functionality and area of application. The list shows an overview of possible products with the plastics mentioned.**

## Machine design and design requirements

### Components conforming to standards

The practical application of the theoretical principles outlined in EN 1672-2 and DIN ISO 14159 is of the essence for the hygienic design of machines and components. These standards specify the fundamental design elements to be used in the construction of systems.

### Surfaces

A high surface finish is absolutely essential for parts that come into contact with the product in order to prevent microbial contamination. This is guaranteed through the use of a mean peak-to-valley height of  $\leq 0.8 \mu\text{m}$  according to ISO 468 within the food zone. This means that micro-organisms and spores ranging from 1 to 10  $\mu\text{m}$  in size will be removed from the surface at a cleaning agent flow velocity of 2 m/sec. Components with a peak-to-valley height of  $\leq 3.2 \mu\text{m}$  are often used in the splash zone. As well as having a higher surface finish, these components also have greater corrosion resistance. A smooth surface can be achieved through grinding, blasting and electropolishing, for example.

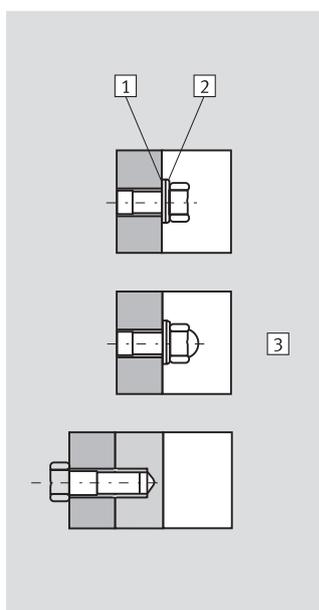


### Connecting pieces, threads

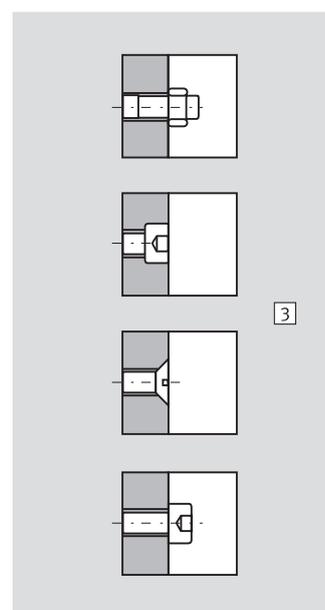
Connecting components such as screws, bolts, rivets and so on may cause hygiene problems. If they are unavoidable for technical reasons, they must be easy to clean and disinfect. Open threads are extremely difficult to clean and provide the perfect breeding ground for germs. The smallest spaces between a metal-metal contact cannot be cleaned.

Any threads that cannot be avoided should therefore be closed off with suitable blanking caps and sealed.

#### Correct



#### Incorrect



- 1 Seal
- 2 Metal stud rubber seal
- 3 Product side

## Machine design and design requirements

### Eddy water

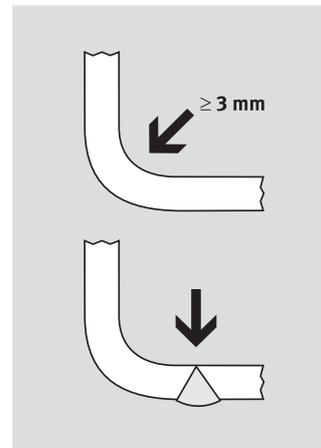
Product containers, production spaces and product lines must be self-draining for liquids or the remaining liquid must be removed via other measures. Product lines must be installed with an incline of at least 3° relative to a drainage point.

Slack pipelines, dead ends and puddles must be avoided at all costs. If any of these requirements cannot be fulfilled, the system should be designed so it can be easily dismantled.

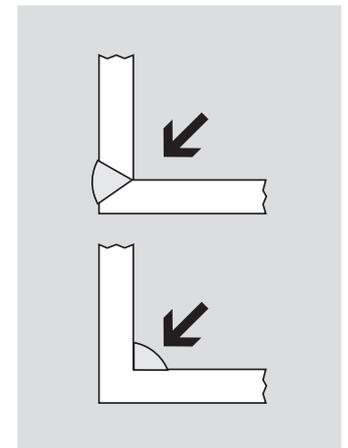
### Inner angles, corners and radii

Very small radii and corners are always a hygiene risk. Because the flow velocities of the cleaning agents and disinfectants are substantially reduced here, the required cleaning effect cannot be achieved. The prescribed minimum radius is 3 mm.

#### Correct



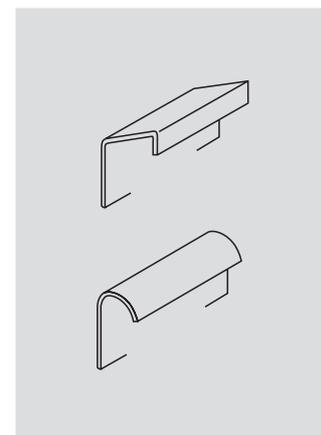
#### Incorrect



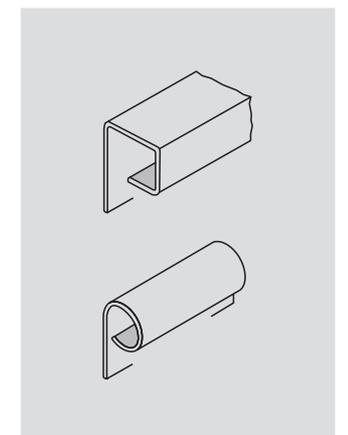
### Dead space, shadow surfaces

All machines and system components must be designed without dead spaces. Any product remnants in these dead spaces cannot be removed and thus cause contamination. Important plant components must therefore be designed to be either completely open or completely sealed.

#### Correct



#### Incorrect



### Bearings and shaft openings

All bearings must be attached outside of the food zone. If this is not possible for technical reasons, they should be lubricated with lubricants approved for use in the food industry.

## Electrical degree of protection



Different test methods and standards can be used in the evaluation of enclosures that provide protection from electrical components or that protect the electrical components from external influences.

### IP degree of protection

The IP (International Protection) class is defined by ICE 60529 "Degree of Protection Provided by Enclosures (IP Code)" (ICE 529) and DIN 40 050 "IP Protection Classes" (standard for electrical equipment in road vehicles).

These standards describe the classification of the degrees of protection provided by enclosures for electrical equipment with rated voltages of up to and including 72.5 kV. They set forth the following:

- Protection of persons against access to dangerous parts within the enclosure (protection against accidental contact)
- Protection of equipment inside the housing against ingress of solid foreign matter, including dust (foreign matter protection)
- Protection of the electrical equipment against damage that would result if water were to enter the enclosure (protection against water)

IP 65



- 1 Digit 1: Protection against ingress of particles
- 2 Digit 2: Protection against ingress of water

### Typical IP degrees of protection in the food and beverage industry

Components with IP degree of protection 65, 66, 67, 68 and 69K are mostly used. In the tables → page 23, the different degrees of protection are explained.

### → Note

Digit 1 encompasses each digit below it. This also applies to digit 2, but only up to number 6.

### NEMA degree of protection

The evaluation of electrical components according to the American NEMA (National Electrical Manufacturers Association) system is performed in accordance with NEMA

Standards Publications 250-1997 "Enclosures for Electrical Equipment (1000 Volts Maximum)". With NEMA 250, enclosures for electrical components with a rated

voltage not exceeding 1000 V are classified by type. They can also be classified by operating environment (dangerous or not dangerous).

3

#### Type 1

Designed for internal use; protection against contact with the enclosed device.

#### Type 3

For external use; protection against wind-borne dust, rain, sleet and external ice formation.

#### Type 4

For internal and external use; protection against wind-borne dust, rain, splash water and water jets.

#### Type 4X

For internal and external use; protection against corrosion, wind-borne dust, rain, splash water and water jets.

#### Type 6

For internal and external use; protection against the ingress of water during occasional temporary submersion at a limited depth.

#### Type 6P

For internal and external use; protection against the ingress of water during prolonged submersion at a limited depth.

#### Type 12

For internal use; protection against dust, falling dirt and dropping non-corrosive liquids.

#### Type 13

For internal use; protection against dust, splash water, oil and non-corrosive coolants.

### → Note

The NEMA standards specify tests for environmental conditions such as corrosion, rust, ice, oil and coolants.

DIN EN 60 529, on the other hand, does not check for these environmental conditions and neither does it specify the degree of protection against mechanical equipment damage.

This, and the fact that the tests and evaluations are based on different characteristic data, means that the IP degree of protection designations cannot be exactly equated with the NEMA enclosure types.

The table → Chapter "Converting NEMA enclosure type numbers to IP classes", page 23 cannot be used to convert IP classes to NEMA enclosure type numbers.

## Digit 1: Protection against the ingress of foreign matter

Digit 1	Brief description	Definition
0	Not protected	–
1	Protected against solid foreign matter, 50 mm and larger	A solid object, a sphere with a diameter of 50 mm, must not fully penetrate the enclosure.
2	Protection against solid foreign matter of 12.5 mm or larger	A solid object, a sphere with a diameter of 12.5 mm, must not fully penetrate the enclosure.
3	Protection against solid foreign matter of 2.5 mm or larger	A solid object, a sphere with a diameter of 2.5 mm, must not penetrate the enclosure at all.
4	Protection against solid foreign matter of 1.0 mm or larger	A solid object, a sphere with a diameter of 1.0 mm, must not penetrate the enclosure at all.
5	Protected against dust	The ingress of dust is not completely prevented. The amount of dust that enters must not impair the safety or satisfactory operation of the equipment.
6	Dustproof	No ingress of dust.

## Digit 2: Degrees of protection against the damaging effects of water

Digit 2	Brief description	Definition
0	Not protected	–
1	Protected against water droplets	Vertically falling droplets must not have any harmful effect.
2	Protected against water droplets	Vertically falling droplets must not have any harmful effect when the enclosure is at an angle of 15° either side of the vertical.
3	Protected against spray water	Water sprayed at any angle of up to 60° either side of the vertical must not have any harmful effect.
4	Protected against water splashes	Water splashing against the enclosure from any angle must not have any harmful effect.
5	Protected against water jets	Water jets directed at the enclosure from any angle must not have any harmful effect.
6	Protected against powerful water jets	Powerful water jets directed against the enclosure from any angle must not have any harmful effect.
7	Protected against the effect of brief submersion in water	Water must not enter the equipment in amounts that can have a harmful effect if the enclosure is briefly submerged in water under standardised pressure and time conditions.
8	Protected against the effect of continuous submersion in water	Water must not enter the equipment in amounts that can have a harmful effect if the enclosure is continuously submerged in water. The conditions must be agreed between the manufacturer and the user. The conditions must, however, be more severe than digit 7.
9K	Protected against water from high-pressure and steam jet cleaning	Water directed at the enclosure from any angle under high pressure must not have any harmful effect.

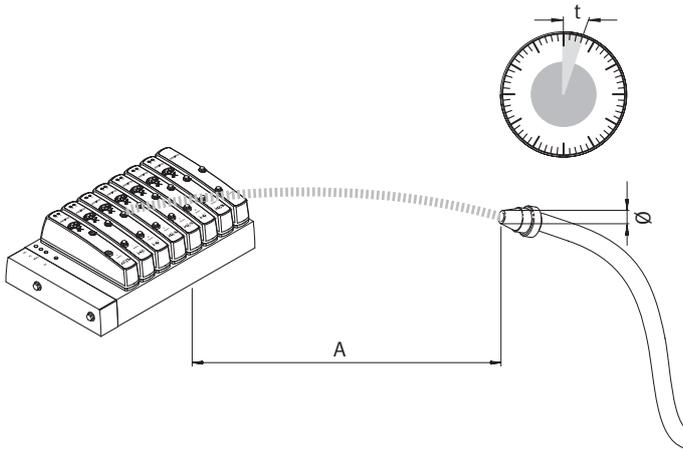
## Converting NEMA enclosure type numbers to IP classes

NEMA enclosure type number	IP class
1	IP10
3	IP54
4 and 4X	IP56
5	IP52
6 and 6P	IP67
12	IP52
13	IP54

[from NEMA 250-1997]

## Test specifications for the definition of IP degrees of protection

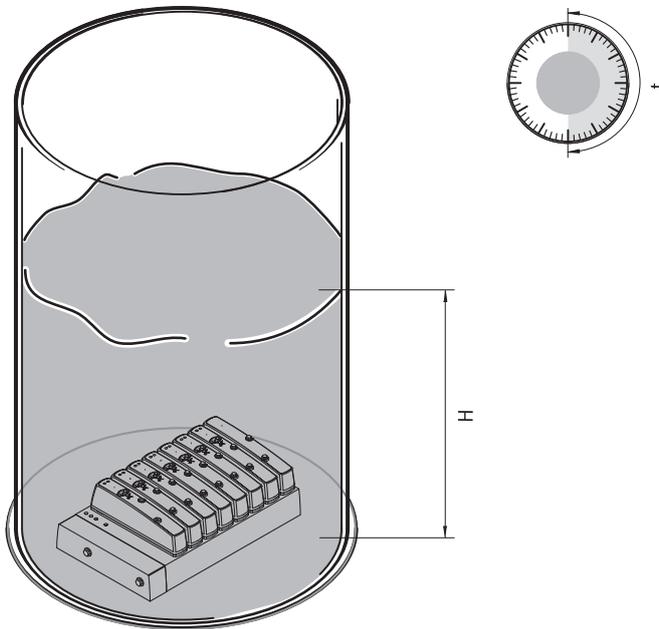
IP 65,  
IP 66



**IP 65:**  
 $A = 2500 \dots 3000 \text{ mm}$   
 $\varnothing = 6.3 \text{ mm}$   
 $t = 3 \text{ min}$   
 $p = 0.3 \text{ bar}$   
 $Q = 12.5 \text{ l/min}$

**IP 66;**  
 $A = 2500 \dots 3000 \text{ mm}$   
 $\varnothing = 12.5 \text{ mm}$   
 $t = 3 \text{ min}$   
 $p = 1 \text{ bar}$   
 $Q = 100 \text{ l/min}$

IP 67,  
IP 68



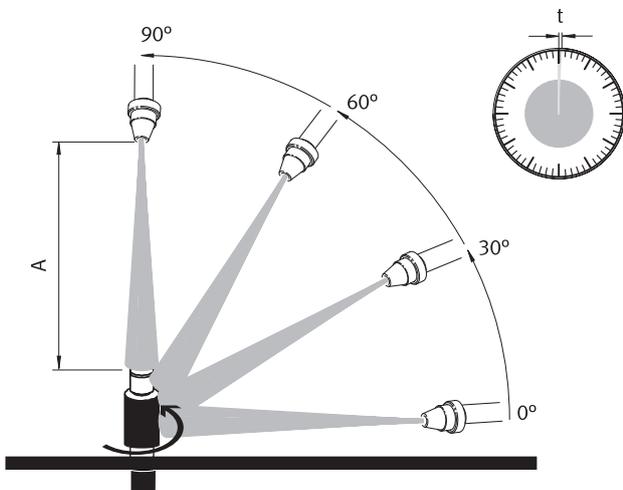
**IP 67;**  
 $H = 150 \dots 1000 \text{ mm}$   
 $t = 30 \text{ min}$

**→ IP 68;**

The test conditions are to be agreed between manufacturers and users. However, the test conditions must be higher than IP 67.

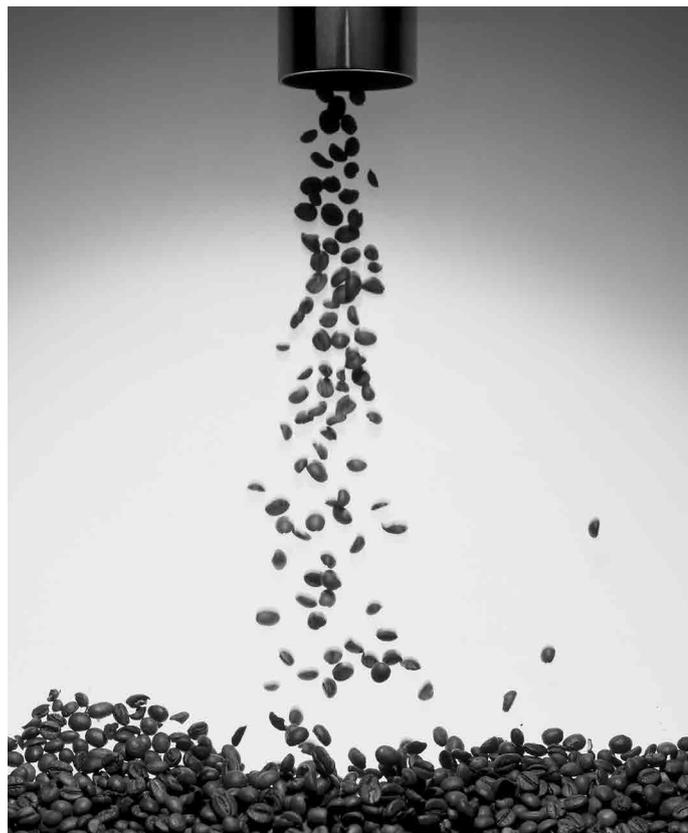
3

IP 69K



$A = 100 \dots 150 \text{ mm}$   
 $t = 30 \text{ sec/position}$   
 $p = 80 \dots 100 \text{ bar}$   
 $Q = 14 \dots 16 \text{ l/min}$   
 $T = 80 \text{ °C}$

## Compressed air quality in the food and beverage industry



Care has to be taken wherever compressed air comes into contact with food because compressed air is not clean by nature. On the contrary, solids and particles in various concentrations are present almost everywhere in the form of dust. Water, in the form of natural humidity, is released in large quantities when the compressed air cools down. And thus compressed air quality in accordance with the requirements of the application provides the best possible safety for food, consumers and food producers.

### → Note

For more on this, see our Service → "Chapter Energy Saving Services" > "Compressed air quality analysis", page 89

### Standards-compliant compressed air preparation

Extremely strict demands are made of the compressed air quality in the food and beverage industry. Adherence to them is important in order to ensure the best possible food safety, and thus reduce the risks for consumers as well.

International standards are helpful in this respect. ISO 8573-1:2010, for example, represents the key quality requirements for compressed air and specifies the maximum amount of contaminants and particle sizes that can be present in each class. At the same time, clear-cut and transparent standards provide us with the opportunity of penetrating global markets.

To make sure that compressed air preparation for automation solutions complies with the standard and is energy efficient, various parameters need to be observed, such as the quality classes for

- solid particles,
- water content and
- total oil content.

A definition of these parameters is included in ISO 8573-1:2010.

## Compressed air quality classes to ISO 8573-1:2010

ISO 8573-1:2010	Solid particles			Mass concentration mg/m <sup>3</sup>	Water		Oil
	Max. number of particles per m <sup>3</sup>				Pressure dew point	Liquid	Total oil content (liquid, aerosol and vapour)
	0.1 ... 0.5 µm	0.5 ... 1 µm	1 ... 5 µm		°C	g/m <sup>3</sup>	mg/m <sup>3</sup>
0	In accordance with specifications by the device user, stricter requirements than Class 1						
1	≤ 20,000	≤ 400	≤ 10	–	≤ –70	–	0.01
2	≤ 400,000	≤ 6,000	≤ 100	–	≤ –40	–	0.1
3	–	≤ 90,000	≤ 1,000	–	≤ –20	–	1
4	–	–	≤ 10,000	–	≤ +3	–	5
5	–	–	≤ 100,000	–	≤ +7	–	–
6	–	–	–	≤ 5	≤ +10	–	–
7	–	–	–	5 ... 10	–	≤ 0.5	–
8	–	–	–	–	–	0.5 ... 5	–
9	–	–	–	–	–	5 ... 10	–
X	–	–	–	> 10	–	>10	>10

## Compressed air quality in the food and beverage industry

### Success factors for correct compressed air preparation

Different compressed air qualities are required at different points within the production system. This necessitates a carefully thought-out concept for the efficient use of compressed air preparation, which should take the special requirements for the production of each type of food into consideration. A combination of centralised, basic compressed air preparation and decentralised auxiliary preparation is advisable.

#### → Compressed air as pilot air

In most cases, compressed air is used as pilot air, for example in order to control valves, cylinders and grippers. For this type of application, contamination only needs to be removed from the compressed air in order to protect the pneumatic components against corrosion and excessive wear. Class 7:4:4 is recommended in this case, which can be achieved by means of a central refrigeration dryer with oil separator and a coarse particle filter (40 µm).

#### → Compressed air comes into direct contact with dry foods (e.g. cereal, milk powder)

The compressed air is used for transporting and mixing, as well as for food production in general. It comes into direct contact with the food. Because these foods are dry, even stricter requirements apply with regard to air humidity.

The following compressed air quality classifications in accordance with ISO 8573-1:2010 apply in this case:

- Solid particles: Class 1
- Water: Class 2
- Oil: Class 1



Filter cascade for compliance with class 1:2:1



EXAMPLE:  
Adsorption dryer PDAD for targeted, decentralised compressed air drying

#### → Important note

In special cases, it is advisable to use a sterile filter, if possible in direct proximity to the consuming device.

#### → Compressed air as process air

Significantly higher levels of purity are required when compressed air is used as process air, e.g. for blowing out moulds, or when it comes directly into contact with food. However, this is usually limited to specific locations. Decentralised compressed air preparation, as close as possible to the consuming device, is advisable in this case. Therefore only the required amount of air is prepared to the higher purity level, thus resulting in energy savings. Close proximity of compressed air preparation to the consuming device also minimises the danger of recontamination of highly purified air in the piping network, for instance with rust particles.

#### Filter cascades for typical applications

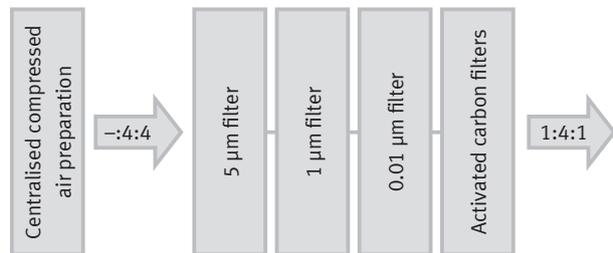
The sole purpose of ISO 8573-1:2010 is to define quality classes. It makes no recommendations about the degree of compressed air purity that should be specified in the food industry. Guidelines and recommendations issued by, for example, the VDMA and the BCAS offer assistance in specifying suitable filter cascades.

#### → Compressed air comes into direct contact with non-dry food (e.g. drinks, meat, vegetables)

The compressed air is used for transporting and mixing, as well as for food production in general. It comes into direct contact with the food.

The following compressed air quality classification in accordance with ISO 8573-1:2010 applies:

- Solid particles: Class 1
- Water: Class 4
- Oil: Class 1



Filter cascade for compliance with class 1:4:1



EXAMPLE:  
Service unit combination MS6 from Festo for compliance with class 1:4:1

#### → Tip

In packaging machines  
The compressed air comes into direct contact with the materials in which the food will be packaged. This makes the packaging material part of the food zone.

## HACCP – Hazard Analysis Critical Control Points

HACCP is a systematic process for identifying, evaluating and preventing risks and hazards.

The objective of the concept is to reduce increased hygiene risks in food products through continuous, integrated process controls.

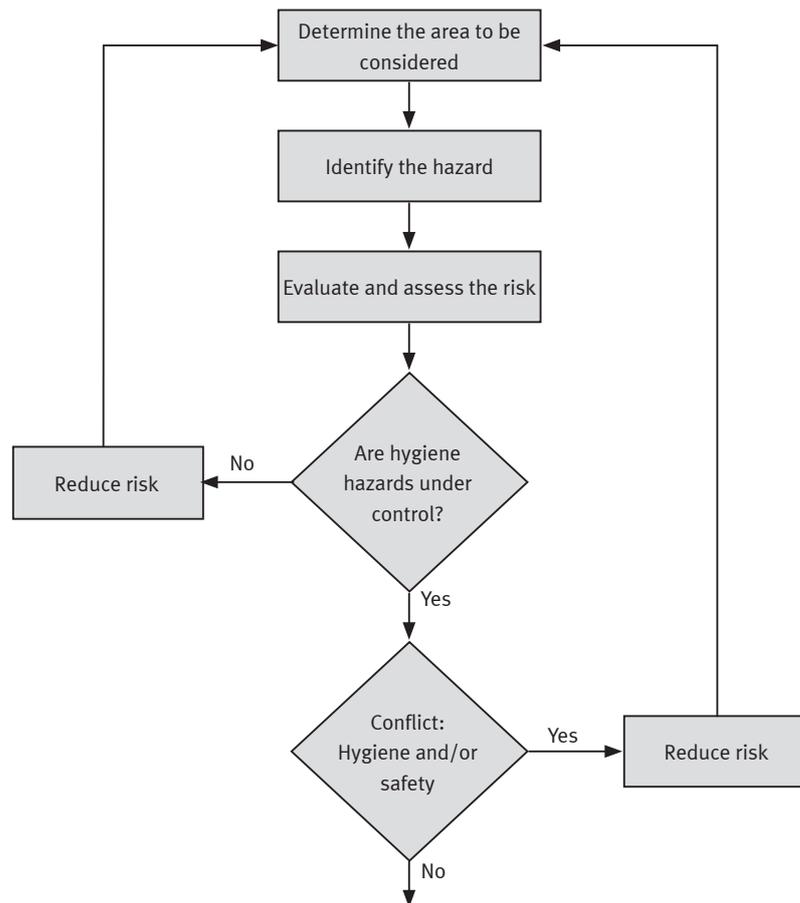
### Individual responsibility

HACCP systems force companies to assume responsibility for ensuring the safety of food products.

Every manufacturer involved in the food industry in the European Union must ensure the quality of its food products and the prevention of any health risks to consumers.

### → HACCP

H=Hazard  
A=Analysis  
C=Critical  
C=Control  
P=Points



Abstract from HACCP, no complete picture of analysis

**Certificate**

**Festo manufacturer's declaration**

Certifies the food safety for products in accordance with Directive

1935/2004. All certificates are available on the Support Portal.

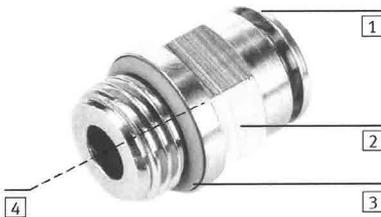
→ [www.festo.com/sp](http://www.festo.com/sp)

**Certificate**

Date  
October 29, 2013

Festo AG & Co. KG hereby confirms the accordance with the general requirements of **Regulation (EC) No 1935/2004 of 27 October 2004 on materials and articles intended to come into contact with food.**

This applies for connectors, push-in fittings, push-in sleeves, plug screws and blanking plugs of the series **NPQH**:



including the following materials which come into contact with food:

Materials and articles which come into contact with food	Material designation	Group of materials and articles	Comment
1 Releasing ring	CuZn39Pb3	Metal	ANSI/NSF 51, Annex A
2 Housing	CuZn40Pb2	Metal	ANSI/NSF 51, Annex A
3 Thread seal	FPM	Elastomer	FDA 21 CFR 177.2600
4 Inboard parts			
Snap sleeve, thrust ring	PEI	Thermoplastic	FDA 21 CFR 177.1595
Disc-spring washer	1.4310	Metal	ANSI/NSF 51
Tube seal	FPM	Elastomer	FDA 21 CFR 177.2600

Regardless of this indication, the technical data and conditions of use as described in the Festo catalogue and/or the operating instructions have to be observed in order to ensure the safe operation of the product in each individual application. Furthermore, please also observe the following vitally important note: Component parts or materials of component parts which are not explicitly listed above do not comply with the appropriate rules of food grade compliance. Overall Migration Limit, Specific Migration Limit and other Material Restrictions as specified in Regulation (EU) no. 10/2011 or the applied FDA rules shall be carried out by the user on the final article.

Stefan Maresch  
Product Development Support Functions

Doris Messer  
Product Certification

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Page(s)  
1 of 1

3

## The challenge of cleaning – properly and safely!



The topic of industrial food production is particularly important in industrial food production. Hence it is essential in the area of hygienic food production that every manufacturer take responsibility for its products.

Flawless product safety – especially from a microbiological standpoint – is of the essence in order to protect the consumer. Top priority is accorded to preventing the spread of germs and eliminating foreign particles. Proper cleaning helps to protect your customers and your brand.

Optimum, appropriate cleaning saves time and money.

The primary influencing factors are:

Temperature	Time
Mechanics/force	Concentration

The correct selection of components for safe operation and optimum cleaning:

Only seals and lubricants approved for use (e.g. FDA) with food are to be used for operation in contact with food. Depending on the requirements of the specific application, there is a choice of valve types either for normal cleaning or for applications using intensive foam cleaning.

Intensive cleaning of machine parts can also wash out the lubricating grease and impair the effectiveness of the components. Using unlubricated seals ensures that the washed out machine components still function reliably.

Different types of cleaning agents are used depending on the areas/surfaces to be cleaned. Gel, foam or liquid cleaning agents adhere to surfaces in varying degrees and should thus be applied differently. This results in the different necessary cleaning processes.

## The cleaning process

### Dry cleaning

Dry cleaning is generally used to remove any loose or easy to remove dirt.

Depending on the type of contamination, dry cleaning is usually followed by wet cleaning.

Dry cleaning is restricted to

- Sweeping brushes
- Dry wipes
- Brushes
- Suction

### High pressure cleaning

Procedure:

1. Preparation (manually remove coarse contamination)
2. Pre-cleaning with water (with-out/reduced pressure)

3. Main cleaning with cleaning agent

4. Application time (if specified by the cleaning agent)
5. Rinsing with water
6. Visual inspection/test strips

### Low-pressure foaming method

Procedure:

1. Preparation (manually remove coarse contamination)
2. Pre-cleaning with water (with-out/reduced pressure)

3. Main cleaning with cleaning agent

4. Application time (if specified by the cleaning agent)
5. Rinsing with water
6. Visual inspection/test strips

### Special cleaning processes

In order to clean system parts outside and inside in accordance with the hygiene regulations, additional special methods must be used:

- Flush through
- Spraying
- Filling
- Scraping

## Cleaning processes

The above-mentioned cleaning methods can be used for different cleaning processes.

### → Please note:

CIP is frequently also called cleaning in process. According to the definition by the EHEDG, however, it is actually cleaning in place, i.e. the parts and components are cleaned in their installed position as opposed to during the actual process.

### CIP – Cleaning in Place

An automatic process ensures complete cleaning/disinfection. The system parts and components need not be disassembled for cleaning. This takes place in accordance with a specific procedure that has been stipulated by the manufacturer.

### COP (Cleaning Out of Place)

System parts and/or components are disassembled for cleaning. Manual and automatic (e.g. washing machine) cleaning can be used here.

### SIP (Sterilisation In Place)

An automatic process sterilises the designated areas completely. The system parts and components need not be disassembled for sterilisation. This takes place in accordance with a specific procedure that has been stipulated by the manufacturer.

### SOP (Sterilisation Out of Place)

System parts and/or components are disassembled for sterilisation. Manual and automatic (e.g. washing machine) sterilisation can be used here.

## Cleaning and disinfecting agents

### The basic characteristics of cleaning agents

From: DIN 10516

There are differences between the various cleaning agents that are suitable for use in the food zone. However, several basic characteristics are imperative in order to ensure the effectiveness of the cleaning agent on a day-to-day basis.

- Quick, complete solubility in water

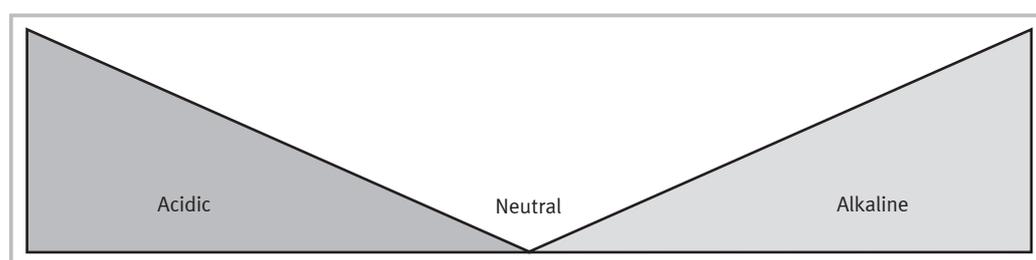
- Equally good wettability of all surface materials to be cleaned
- Fast soaking and removal of food residues or their main ingredients (i.e. fats, proteins, carbohydrates, yeast, fruit flesh, etc.)
- Absence of foaming or antifoaming power
- Compatibility with surfaces to be cleaned without causing corrosion

- Good rinsability
  - Environmental compatibility
  - No risk for personnel
- No single chemical demonstrates all of these characteristics. This means that a combination of chemicals is required within which each substance performs a predefined task as part of a complex cleaning process.

### Selecting a cleaning agent

The appropriate cleaning agent is selected based on the type of contamination, the corrosion resistance of the parts and components to be cleaned and the cleaning and/or disinfecting process.

- Acidic cleaning agents
- Neutral cleaning agents
- Alkaline cleaning agents
- Disinfectants



## Range of applications for cleaning and disinfecting substances

Lyes	E.g. caustic soda for removing organic substances
Acids	E.g. phosphoric acid, nitric acid for removing inorganic constituents and salts
Surfactants (tensides)	Tensides are used to lower the surface tension of water. They also penetrate and emulsify contaminants (fats, proteins, etc.).
Per compounds	Oxygen-hydrolysing compounds (oxidants) such as hydrogen peroxide and peracetic acid. Fast-acting and very aggressive.
Active chlorine compounds	Oxidants, preferably only to be used at temperatures up to 70 °C (DIN 11 483).
Alcohol compounds	Ideal as a fast-acting disinfectant and surface disinfectant.
Quaternary ammonium compounds (QAC/tensides)	Strong surface activity for good wetting and material compatibility

## Evaluation of effectiveness of cleaning and disinfecting substances

	Lyes	Acids	Oxidants	Tensides
<b>Proteins</b>	+++	+	*	+
<b>Grease</b>	+	–	*	+++
<b>Low-molecular carbohydrates</b>	+++	+++	0	0
<b>High-molecular carbohydrates</b>	+	+	++	*
<b>Salts</b>	–	++	0	0

+++ : Very good; ++ : Good; + : Suitable; \* : In specific cases; – : Unsuitable; 0 : Not necessary

## Cleaning and disinfecting agents (generic for typical ingredients)

Product	US name	Cleaning agent type	Tubing				
			PUN	PAN	PUN-H	PLN	PFAN
							
P3-topax 12	Quorum Pink II HF/TFC Pink, Lift III	Neutral	-	+	+	+	+
P3-topax 17	Quorum Pink II HF/TFC Pink, Lift III	Alkaline, free of chlorine	-	+	+	+	+
P3-topax 19	Quorum TFC Green, LFC 390	Alkaline	-	o	o	+	+
P3-topax 36		Highly alkaline	-	o	o	+	+
P3-topax 37		Alkaline	-	o	o	+	+
P3-topax 52	Foam-Shine, Quorum Red/Purple	Acidic	-	-	+	+	+
P3-topax 56		Acidic	-	-	+	+	+
P3-topax 65		Alkaline	-	-	-	+	+
P3-topax 66	Enforce LP - not antimicrobial	Alkaline	-	-	o	+	+
P3-topax 686		Alkaline	-	-	o	+	+
P3-topax 91	Ster-Bac Quat, Quorum Clear V	Neutral	-	+	+	+	+
P3-topax 95		Contains chlorine	-	-	o	o	+
P3-topax 960		Alkaline	-	o	o	+	+
P3-topax 990		Neutral	-	+	+	+	+
P3-topactive 200	TFC Green II, SHC Extreme II	Alkaline	-	o	o	+	+
P3-topactive 500	TFC Red	Acidic	-	-	+	+	+
P3-topactive DES	Vortexx	Acid oxidative	-	-	-	+	+
P3-topactive OKTO		Acid oxidative	-	-	-	o	+
P3-topactive LA	Quorum TFC Pink	Alkaline	-	+	+	+	+
P3-alcodes	RTU Surface Sanitizer	Neutral	-	+	+	+	+
P3-sterile		Neutral	-	+	+	+	+
P3-riksol		Alkaline	-	+	+	+	+
P3-ansep ALU		Contains active chlorine	-	-	o	+	+
P3-ansep CIP		Contains active chlorine	-	-	o	+	+
P3-aquanta PA		Acidic	-	-	+	+	+
P3-aquanta XTR		Neutral	-	+	+	+	+
P3-AR EXTRA		Alkaline, free of chlorine	-	o	o	+	+
P3-liquid OS		Alkaline	-	-	o	+	+
P3-hypochloran		Contains active chlorine	-	-	o	+	+
P3-oxonia active		Acid oxidative	-	-	-	+	+
P3-oxonia active 150		Acid oxidative	-	-	-	+	+
P3-horolith CIP		Acidic, contains tensides	-	-	+	+	+
P3-horolith V		Acidic, free of tensides	-	-	-	+	+
P3-mip BM		Alkaline	-	o	o	+	+
Mip C		Highly alkaline	-	o	o	+	+
Mip SCA		Highly alkaline	-	o	o	+	+
Mip MX		Alkaline	-	o	o	+	+
Mip CA		Highly alkaline	-	o	o	+	+
P3-oxysan ZS		Acid oxidative	-	-	-	o	+

+: Resistant; o: Resistant to a limited extent; -: Not resistant

## Cleaning and disinfecting agents (generic for typical ingredients)

Cylinder			Seal			Valve	Fitting			
Corrosion protection			PUR	MEDIA	FPM	CDVI	NPQH	NPQP	CRQS	NPCK
Standard	Increased	High								
CRC 0/1	CRC 2	CRC 3/4								
+	+	+	-	+	+	+	+	+	+	+
+	+	+	-	+	0	+	0	+	0	+
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-	-	+	-	+	+	+	-	0	+	+

+: Resistant; 0: Resistant to a limited extent; -: Not resistant

## Cleaning and disinfecting agents (generic for typical ingredients)

Product	Comment	Tubing				
		PUN	PAN	PUN-H	PLN	PFAN
						
<b>Acifoam VF10</b>	Acidic foam cleaning agent	-	-	o	+	+
<b>Acigel VG07</b>	Acidic gel cleaning agent	-	-	o	+	+
<b>Aluwash VA03</b>	Acidic cleaning agent	-	-	-	+	+
<b>Cipsafe VC18</b>	Alkaline cleaning agent	-	+	+	+	+
<b>Complex VB13</b>	Alkaline cleaning additive	-	+	+	+	+
<b>Delladet VS02</b>	Mildly alkaline disinfectant cleaning agent	-	+	+	+	+
<b>Deltafoam VF08</b>	Mildly alkaline foam cleaning agent	-	+	+	+	+
<b>Dicolube HCS VL 70</b>	Belt lubricant	-	+	+	+	+
<b>Dicolube RS 148 (new)</b>	Belt lubricant	-	+	+	+	+
<b>Dicolube Sustain VL108</b>	Belt lubricant	-	+	+	+	+
<b>Diverfoam Active</b>	Acidic disinfectant	-	-	o	+	+
<b>Diverfoam SMS Chlor VF18</b>	Chlorine alkaline foam cleaning agent	-	-	+	+	+
<b>Diverside PD VF49</b>	Alkaline cleaning agent	-	-	+	+	+
<b>Divo Peroxy VB70</b>	Acidic cleaning additive	-	-	o	+	+
<b>Divodes FG VT29</b>	Alcoholic disinfectant	-	o	-	+	+
<b>Divosan Active VT05</b>	Acidic disinfectant	-	-	o	+	+
<b>Divosan Extra VT55</b>	Neutral disinfectant	-	+	+	+	+
<b>Divosan Hypochlorite VT03</b>	Chlorine alkaline disinfectant	-	-	+	+	+
<b>HD Plusfoam VF01</b>	Highly alkaline foam cleaning agent	-	+	+	+	+
<b>Highstar VC77</b>	Highly alkaline cleaning agent	-	+	+	+	+
<b>Hypogel VG08</b>	Chlorine alkaline gel cleaning agent	-	-	+	+	+
<b>Mach 5 VC10</b>	Highly alkaline cleaning agent	-	+	+	+	+
<b>NP Freefoam VF11</b>	Acidic foam cleaning agent	-	-	-	+	+
<b>Oxofoam VF05</b>	Chlorine alkaline foam cleaning agent	-	-	+	+	+
<b>Pascal VA05</b>	Acidic cleaning agent	-	-	-	+	+
<b>Powergel VG01</b>	Alkaline gel cleaning agent	-	+	+	+	+
<b>Safeoam VF09</b>	Mildly alkaline foam cleaning agent	-	+	+	+	+
<b>Sanifoam VF33</b>	Alkaline foam cleaning agent	-	+	+	+	+
<b>Sanigel VG04</b>	Alkaline gel cleaning agent	-	+	+	+	+
<b>Shureclean VK10</b>	Neutral cleaning agent, foaming	-	+	+	+	+
<b>Superfoam VF03</b>	Alkaline foam cleaning agent	-	+	+	+	+
<b>Supergel VG03</b>	Alkaline gel cleaning agent	-	+	+	+	+
<b>Suredis VT01</b>	Mildly alkaline disinfectant	-	+	+	+	+
<b>Surefoam VF62</b>	Alkaline disinfectant cleaning agent	-	+	+	+	+
<b>Tego 2000 VT25</b>	Mildly alkaline disinfectant	-	+	+	+	+
<b>Ultraclean VK03</b>	Mildly alkaline cleaning agent	-	+	+	+	+

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## Cleaning and disinfecting agents (generic for typical ingredients)

Cylinder			Seal			Valve	Fitting			
Corrosion protection			PUR	MEDIA	FPM	CDVI	NPQH	NPQP	CRQS	NPCK
Standard	Increased	High								
CRC 0/1	CRC 2	CRC 3/4								
-	o	+	o	+	+	+	o	+	+	+
-	o	+	o	+	+	+	o	+	+	+
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-	-	+	+	+	-	+	o	+	o	+
+	+	+	+	+	+		+	+	+	+
o	o	+	+	+	o	+	+	+	+	+

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## Production areas and machine zones

Spick and span solutions for automation in all four areas of the food and beverage industry.

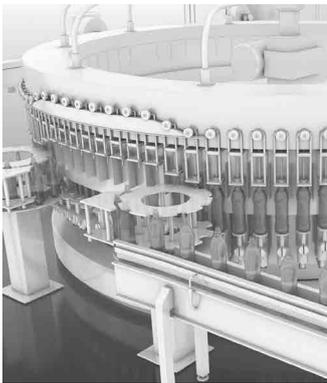
Please note: The following pages contain only a selection of the products available. Further information on the food and beverage industry can be found at [www.festo.com](http://www.festo.com)

### ➔ Note

The assessment criteria for allocating products to the food/splash zone are:

- Corrosion resistance class CRC (incorporates the roughness and material)
- Design (ease of cleaning)
- Approval certificates/standards (1935/2004, FDA...)
- Lubricant (NSF-H1)

## Food zone



The food zone encompasses all system parts and components that come into contact with food. In other words, the component is mounted directly within the food flow or food comes into contact with the component before being returned to the product flow. Parts that come into contact with food must be easy to clean and disinfect. They must also be corrosion-resistant, non-toxic, non-absorbent, smooth and of one-piece construction or sealed in order to prevent food particles collecting in small gaps. Parts that are difficult to remove pose a contamination hazard. In addition, only special food-compatible lubricants may be used. These requirements also apply to parts that are dismantled for cleaning.

Special features:

- Direct contact with food
- Food return to the product flow

Functions:

- Portioning
- Bottling
- Forming
- Filling
- Closing

Symbol for suitability in the food zone



## Splash zone



Machine parts and components in the splash zone come into direct contact with food. The food cannot be returned to the product flow from this zone. However, the splash zone should still be planned and designed according to the same criteria as the food zone – even if the product cannot be returned to the food process. The technical implementation can be less stringent, provided this does not have an unfavourable effect on the quality of the manufacturing process.

Special features:

- Direct contact with food
- Food do not return to the product flow

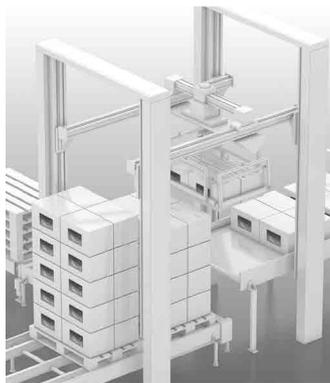
Functions:

- Portioning
- Bottling
- Closing

Symbol for suitability in the splash zone



## Non-food zone



In the non-food zone, machine components do not come into contact with food. Nevertheless, all of the parts and system components used in this zone should be manufactured from corrosion-resistant materials and be easy to clean and disinfect. This should help to make sure that risks are avoided wherever possible. Packaging installation components must meet very specific requirements. They need to be smaller, more versatile and more compatible than other components. Impurities such as mineral oils, metal particles etc. must not enter the food during the packaging process.

Another important factor is compressed air preparation up to the required quality level in order to exclude the possibility of faults and material wear.

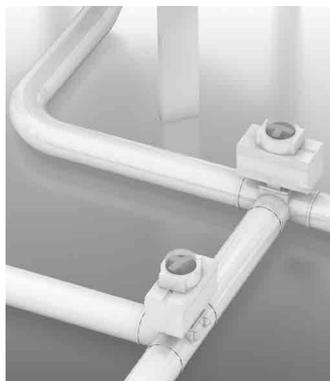
Special features:

- Dry: no contact with food and cleaning agents
- Wet: no contact with food, but contact with cleaning agents possible

Functions:

- Wrapping
- Labelling
- Inspecting and checking

## Process automation



Throughout the entire production process – from handling the raw materials for food production to sewage treatment – Festo offers a range of suitable products and complete solutions for the automation of continuous processes. All products are, of course, certified for use in the food industry and meet all relevant requirements for the application in question.

Processes in the food zone:

- Mixing and stirring
- Sterilising
- Pasteurising
- Homogenising
- Filtering
- Metering
- Weighing
- Bottling
- Ensiling

The food industry has many other possible applications for products from the process automation range, including processes in the non-food zone, for example:

Media preparation  
Cleaning, water treatment  
Wastewater disposal

## Software tool: Configurator

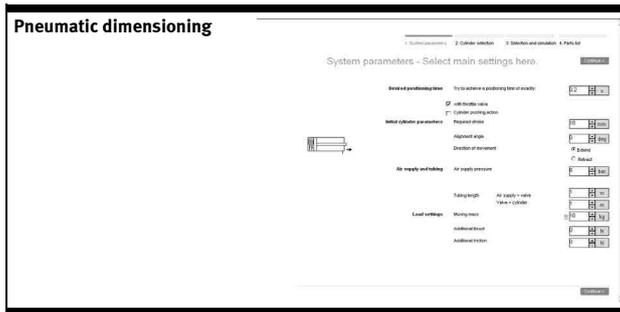


Design a product with numerous features reliably and quickly with the help of the configurator.

Select all the required product features step-by-step. The use of logic checks ensures that only correct configurations are available for selection.

The configurator is part of the electronic catalogue and is not available as a separate software program.

## Software tool: Pneumatic dimensioning



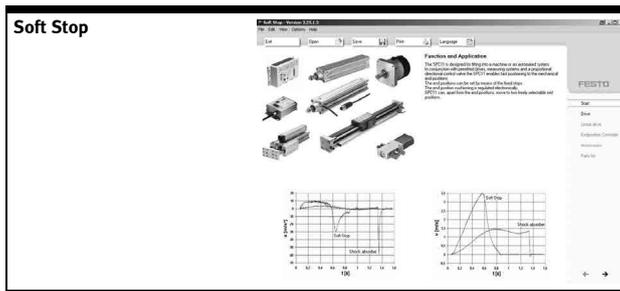
Perfect simulations replace expensive actual tests.

The tool is an expert system that supports you in the selection and configuration of the entire pneumatic control chain. If one parameter is changed, the program automatically adapts all the others.

This tool can be found

- in the electronic catalogue via the blue icons in the product tree underneath the search field, or
- on the website under Support in the Engineering software area, or
- on the DVD under Selection and sizing.

## Software tool: Soft Stop

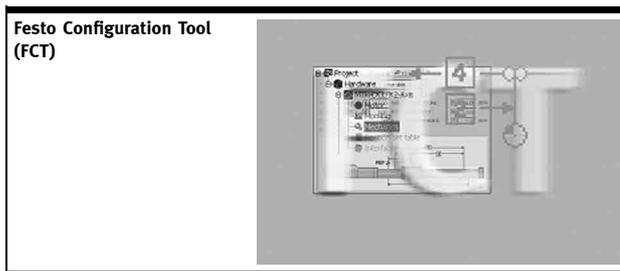


Soft Stop virtually makes the impossible possible. Travel times are reduced by as much as 30% for pneumatic drives and vibration is also greatly reduced. The selection program performs all of the necessary calculations.

This tool can be found

- in the electronic catalogue via the blue icons in the product tree underneath the search field, or
- on the website under Support in the Engineering software area, or
- on the DVD under Selection and sizing.

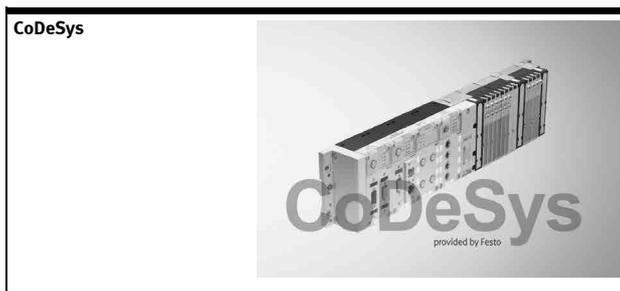
## Software tool



FCT is a configuration and parameterisation software program that supports all Festo devices, in particular motor controllers. It is extremely flexible, provides full support for the device properties and is simple and intuitive to operate. The user is guided step-by-step through the commissioning process while each individual step is checked.

The FCT parameterisation software can be found on the website under Support in the Support and Downloads area. Enter FCT as a search term to retrieve it.

## Software tool



CoDeSys for standardised programming of embedded devices to IEC 61131-3. It makes your life easier with simple commissioning, fast programming and parameterisation.

### Advantages

- Hardware-neutral software platform for quick and easy configuration, programming and commissioning of pneumatic and electrical automation solutions
- Extensive module libraries for single or multi-axis positioning motions

- The IEC 61131-3 standard means that CoDeSys is flexible and open for all types of control tasks
  - Modular: offline and online functions, as well as components for hardware configuration and visualisation
  - User-friendly IEC function block extension
  - Re-use of existing application parts
- The CoDeSys parameterisation software can be found on the website under Support › Support Portal › enter search term.

## Software tool: Product finder

**Product finder**



A secure grip is a question of the right calculation. In this case, calculation of weight, direction of movement, distances, etc. The software tool immediately determines which type of gripper – parallel, three-point, angle or swivel/gripper – and which size best matches your requirements.

This tool can be found

- in the electronic catalogue via the blue icons in the product tree underneath the search field, or
- on the DVD under Selection and sizing.

## Software tool: PositioningDrives

**PositioningDrives**



Which electromechanical linear drive best meets your needs? Enter the data for your application, such as position values, effective loads and mounting position, and the software suggests a number of solutions.

This tool can be found

- in the electronic catalogue via the blue icons in the product tree underneath the search field, or
- on the website under Support in the Engineering software area, or
- on the DVD under Selection and sizing.

## Software tool: Product finder

**Product finder**



Which suction cup for which surface and which movement? Don't experiment – calculate! This software tool even enables a differentiation to be made between linear and rotary movements.

This tool can be found

- in the electronic catalogue via the blue icons in the product tree underneath the search field, or
- on the DVD under Selection and sizing.

## Software tool: Product finder for valve terminals

**Product finder for valve terminals**

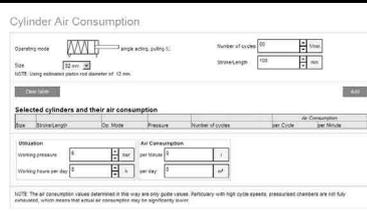


Find the right valve terminal quickly with the help of the product finder. Start the product finder via the blue icons in the product tree. Select your technical features on the left-hand side step-by-step; the selection of suitable products on the right-hand side is automatically updated to reflect the chosen technical features.

The use of logic checks ensures that only correct configurations are available for selection. The product finder for valve terminals is part of the electronic catalogue and is not available as a separate software program.

## Software tool: Air consumption

**Air consumption**



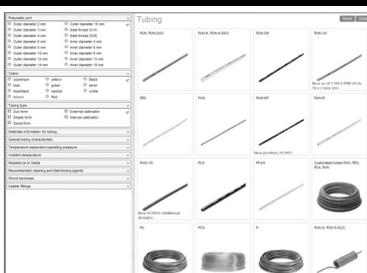
Calculate your system's air consumption quickly and conveniently. Simply enter all the drives and tubing, set the cycle times and working pressure and the air consumption per minute and per day will be calculated for you. It includes a feature for exporting the input table together with the result directly to Excel.

This tool can be found

- in the electronic catalogue via the blue icons in the product tree underneath the search field, or
- on the website under Support in the Engineering software area, or
- on the DVD under Selection and sizing.

## Software tool: Product finder

**Product finder**



Simply enter parameters such as working pressure, chemicals and required resistance to cleaning agents and have the program calculate the right tubing for your application.

This tool can be found

- in the electronic catalogue via the blue icons in the product tree underneath the search field, or
- on the DVD under Selection and sizing.

## Standards-based cylinders

Type	 Compact cylinder ADN	 Compact cylinder ADNP	 Compact cylinder, Clean Design CDC	 Standard cylinder DSBC
<b>Mode of operation</b>	Double-acting	Double-acting	Double-acting	Double-acting
<b>Piston diameter</b>	12mm, 16mm, 20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 80mm, 100mm, 125mm	20mm, 25mm, 32mm, 40mm, 50mm	20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 80mm	32mm, 40mm, 50mm, 63mm, 80mm, 100mm, 125mm
<b>Theoretical force at 6 bar, advancing</b>	51 ... 7,363 N	188 ... 1,178 N	141 ... 3,016 N	415 ... 7,363 N
<b>Stroke</b>	1 ... 500 mm	5 ... 80 mm	1 ... 500 mm	1 ... 2,800 mm
<b>Cushioning</b>	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning	P: elastic cushioning rings/pads at both ends	P: elastic cushioning rings/pads at both ends	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning, PPV: pneumatic cushioning, adjustable at both ends
<b>Description</b>	<ul style="list-style-type: none"> <li>• Piston diameter 12 ... 100 mm in accordance with ISO 21287</li> <li>• Up to 50% less installation space than comparable standard cylinders to ISO 15552</li> <li>• For position sensing</li> <li>• Piston rod with male or female thread</li> <li>• Wide range of variants</li> </ul>	<ul style="list-style-type: none"> <li>• ISO 21287</li> <li>• Up to 50% less installation space than comparable standard cylinders to ISO 15552</li> <li>• With polymer end cap and piston rod made from aluminium</li> <li>• Low-cost cylinder for standard applications</li> <li>• For position sensing</li> <li>• Piston rod with male or female thread</li> </ul>	<ul style="list-style-type: none"> <li>• ISO 21287</li> <li>• Up to 50% less installation space than comparable standard cylinders to ISO 15552</li> <li>• Easy-to-clean design</li> <li>• Increased corrosion protection</li> <li>• For position sensing</li> <li>• Wide range of variants</li> <li>• Piston rod with male or female thread</li> </ul>	<ul style="list-style-type: none"> <li>• ISO 15552 (ISO 6431, VDMA 24562)</li> <li>• With the self-adjusting pneumatic end-position cushioning PPS - adapts perfectly to changes in load and speed</li> <li>• For position sensing</li> <li>• High flexibility thanks to the wide range of variants</li> <li>• An extensive range of accessories makes it possible to install the cylinder virtually anywhere</li> </ul>
<b>Suitable for</b>				
<b>online:</b> →	<a href="#">adn</a>	<a href="#">adnp</a>	<a href="#">cdc</a>	<a href="#">dsbc</a>

## Standards-based cylinders

Type	 Standard cylinder DSBG	 Standard cylinder, Clean Design DSBF	 Standard cylinder DSNU	 Standard cylinder DSNUP
<b>Mode of operation</b>	Double-acting	Double-acting	Double-acting	Double-acting
<b>Piston diameter</b>	32mm, 40mm, 50mm, 63mm, 80mm, 100mm, 125mm, 160mm, 200mm	32mm, 40mm, 50mm, 63mm, 80mm, 100mm	8mm, 10mm, 12mm, 16mm, 20mm, 25mm	16mm, 20mm, 25mm
<b>Theoretical force at 6 bar, advancing</b>	415 ... 18,850 N	415 ... 4,712 N	23 ... 295 N	121 ... 295 N
<b>Stroke</b>	1 ... 2,800 mm	1 ... 2,800 mm	1 ... 500 mm	25 ... 100 mm
<b>Cushioning</b>	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning, PPV: pneumatic cushioning, adjustable at both ends	PPS: self-adjusting pneumatic end-position cushioning, PPV: pneumatic cushioning, adjustable at both ends	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning, PPV: pneumatic cushioning, adjustable at both ends	P: elastic cushioning rings/pads at both ends
<b>Description</b>	<ul style="list-style-type: none"> <li>• ISO 15552 (ISO 6431, VDMA 24562)</li> <li>• Sturdy tie rod design</li> <li>• For contactless position sensing</li> <li>• Optionally with protection against rotation</li> <li>• An extensive range of accessories makes it possible to install the cylinder virtually anywhere</li> </ul>	<ul style="list-style-type: none"> <li>• ISO 15552 with increased corrosion protection</li> <li>• Resistant to conventional cleaning agents</li> <li>• FDA-approved lubrication and sealing on the basic version</li> <li>• Long service life thanks to optional seal for unlubricated operation</li> <li>• Hygienic mounting of the sensors possible</li> <li>• Comprehensive range of mounting accessories for just about every type of installation</li> </ul>	<ul style="list-style-type: none"> <li>• ISO 6432</li> <li>• For position sensing</li> <li>• Wide range of variants</li> <li>• Good running performance and long service life</li> <li>• Piston rod with male or female thread</li> </ul>	<ul style="list-style-type: none"> <li>• ISO 6432</li> <li>• Cost-optimised round cylinder</li> <li>• Wrought aluminium alloy cylinder barrel</li> <li>• Polyamide bearing and end caps</li> <li>• For position sensing</li> </ul>
<b>Suitable for</b>				
<b>online:</b> →	<a href="#">dsbg</a>	<a href="#">dsbf-c</a>	<a href="#">dsnu</a>	<a href="#">dsnup</a>

## Round cylinders

Type	 Round cylinder DSNU
<b>Mode of operation</b>	Double-acting
<b>Piston diameter</b>	32mm, 40mm, 50mm, 63mm
<b>Theoretical force at 6 bar, advancing</b>	482.5 ... 1,870.3 N
<b>Stroke</b>	1 ... 500 mm
<b>Cushioning</b>	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning, PPV: pneumatic cushioning, adjustable at both ends
<b>Description</b>	<ul style="list-style-type: none"> <li>• For position sensing</li> <li>• Wide range of variants</li> <li>• Good running performance and long service life</li> <li>• Piston rod with male or female thread</li> </ul>
<b>online:</b> →	<a href="#">dsnu-32</a>

## Stainless steel cylinders

Type	 Standard cylinder CRDSNU	 Round cylinder CRDSNU	 Standard cylinder CRDNG, CRDNGS	 Round cylinder CRHD
Mode of operation	Double-acting	Double-acting	Double-acting	Double-acting
Piston diameter	12mm, 16mm, 20mm, 25mm	32mm, 40mm, 50mm, 63mm	32mm, 40mm, 50mm, 63mm, 80mm, 100mm, 125mm	32mm, 40mm, 50mm, 63mm, 80mm, 100mm
Theoretical force at 6 bar, advancing	68 ... 295 N	483 ... 1,870 N	483 ... 7,363 N	483 ... 4,712 N
Stroke	1 ... 500 mm	1 ... 500 mm	10 ... 2,000 mm	10 ... 500 mm
Cushioning	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning, PPV: pneumatic cushioning, adjustable at both ends	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning, PPV: pneumatic cushioning, adjustable at both ends	PPV: pneumatic cushioning, adjustable at both ends	PPV: pneumatic cushioning, adjustable at both ends
Description	<ul style="list-style-type: none"> <li>• ISO 6432</li> <li>• Corrosion-resistant in harsh environmental conditions</li> <li>• Easy-to-clean design</li> <li>• Long service life thanks to optional unlubricated seal</li> <li>• For position sensing</li> <li>• Wide range of variants</li> <li>• Wide range of accessories</li> </ul>	<ul style="list-style-type: none"> <li>• Corrosion-resistant in harsh environmental conditions</li> <li>• Easy-to-clean design</li> <li>• Long service life thanks to optional unlubricated seal</li> <li>• For position sensing</li> <li>• Wide range of variants</li> <li>• Wide range of accessories</li> </ul>	<ul style="list-style-type: none"> <li>• ISO 15552 (ISO 6431, VDMA 24562)</li> <li>• Corrosion-resistant in harsh environmental conditions</li> <li>• Easy-to-clean design</li> <li>• Threaded mounting, mounting via accessories</li> <li>• For position sensing</li> <li>• Variants: through piston rod, heat-resistant design</li> </ul>	<ul style="list-style-type: none"> <li>• Corrosion-resistant in harsh environmental conditions</li> <li>• Easy-to-clean design, optimized for exacting demands</li> <li>• Greater flexibility thanks to different end caps</li> <li>• For position sensing</li> <li>• Piston rod with male thread</li> </ul>
Suitable for				
online: →	<a href="#">crdsnu-12</a>	<a href="#">crdsnu-32</a>	<a href="#">crdng</a>	<a href="#">crhd</a>

## Short-stroke cylinders and compact cylinders

Type	 Compact cylinder ADN	 Compact cylinder ADNGF	 Compact cylinder ADNP	 Compact cylinder CDC
<b>Mode of operation</b>	Double-acting	Double-acting	Double-acting	Double-acting
<b>Piston diameter</b>	12mm, 16mm, 20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 80mm, 100mm, 125mm	12mm, 16mm, 20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 80mm, 100mm	20mm, 25mm, 32mm, 40mm, 50mm	20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 80mm
<b>Theoretical force at 6 bar, advancing</b>	51 ... 7,363 N	68 ... 4,712 N	188 ... 1,178 N	141 ... 3,016 N
<b>Stroke</b>	1 ... 500 mm	1 ... 400 mm	5 ... 80 mm	1 ... 500 mm
<b>Cushioning</b>	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning	P: elastic cushioning rings/pads at both ends	P: elastic cushioning rings/pads at both ends
<b>Description</b>	<ul style="list-style-type: none"> <li>Piston diameter 12 ... 100 mm to ISO 21287</li> <li>Up to 50% less installation space than comparable standard cylinders to ISO 15552</li> <li>For position sensing</li> <li>Piston rod with male or female thread</li> <li>Wide range of variants</li> </ul>	<ul style="list-style-type: none"> <li>Mounting hole pattern to ISO 21287</li> <li>Piston rod secured against rotation by means of guide rod and yoke plate</li> <li>Plain-bearing guide</li> <li>For position sensing</li> <li>Available with through piston rod</li> </ul>	<ul style="list-style-type: none"> <li>ISO 21287</li> <li>Up to 50% less installation space than comparable standard cylinders to ISO 15552</li> <li>With polymer end cap and piston rod made from aluminium</li> <li>Low-cost cylinder for standard applications</li> <li>For position sensing</li> <li>Piston rod with male or female thread</li> </ul>	<ul style="list-style-type: none"> <li>ISO 21287</li> <li>Up to 50% less installation space than comparable standard cylinders to ISO 15552</li> <li>Easy-to-clean design</li> <li>Increased corrosion protection</li> <li>For position sensing</li> <li>Wide range of variants</li> <li>Piston rod with male or female thread</li> </ul>
<b>Suitable for</b>				
<b>online:</b> →	<a href="#">adn</a>	<a href="#">adngf</a>	<a href="#">adnp</a>	<a href="#">cdc</a>

## Short-stroke cylinders and compact cylinders

Type	 Short-stroke cylinder ADVC, AEVC	 Flat cylinder DZF	 Flat cylinder DZH
<b>Mode of operation</b>	Double-acting, pushing, single-acting,	Double-acting	Double-acting
<b>Piston diameter</b>	4mm, 6mm, 10mm, 12mm, 16mm, 20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 80mm, 100mm	Equivalentdiameter, 12mm, 18mm, 25mm, 32mm, 40mm, 50mm, 63mm	Equivalentdiameter, 16mm, 20mm, 25mm, 32mm, 40mm, 50mm, 63mm
<b>Theoretical force at 6 bar, advancing</b>	4.9 ... 4,712 N	51 ... 1,870 N	104 ... 1,870 N
<b>Stroke</b>	2.5 ... 25 mm	1 ... 320 mm	1 ... 1,000 mm
<b>Cushioning</b>	P: elastic cushioning rings/pads at both ends	P: elastic cushioning rings/pads at both ends	PPV: pneumatic cushioning, adjustable at both ends
<b>Description</b>	<ul style="list-style-type: none"> <li>Short-stroke cylinder with standard hole pattern to VDMA 24562 from diameter 32 mm</li> <li>Minimal space required</li> <li>High clamping forces in a compact size</li> <li>For position sensing with proximity sensor for T-slot and for C-slot</li> <li>Piston rod with male or female thread</li> </ul>	<ul style="list-style-type: none"> <li>Extremely flat design</li> <li>Protected against rotation thanks to special piston shape</li> <li>Ideal for manifold assembly</li> <li>Wide range of mounting options</li> <li>For position sensing</li> <li>Piston rod with male or female thread</li> </ul>	<ul style="list-style-type: none"> <li>Flat design</li> <li>Protected against rotation thanks to special piston shape</li> <li>Ideal for manifold assembly</li> <li>Wide range of mounting options</li> <li>For position sensing</li> <li>Piston rod with male thread</li> </ul>
<b>online:</b> →	<a href="#">advc</a>	<a href="#">dzf</a>	<a href="#">dzh</a>

## Cylinder with clamping unit

Type	 Compact cylinder with clamping unit ADN-KP	 Standard cylinder with clamping cartridge DSNU-KP	 Round cylinders with clamping cartridge DSNU-KP
<b>Mode of operation</b>	Double-acting	Double-acting	Double-acting
<b>Piston diameter</b>	20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 80mm, 100mm	8mm, 10mm, 12mm, 16mm, 20mm, 25mm	32mm, 40mm, 50mm, 63mm
<b>Theoretical force at 6 bar, advancing</b>	188... 4,712 N	30 ... 295 N	482.5 ... 1,870.3 N
<b>Stroke</b>	10 ... 500 mm	1 ... 500 mm	1 ... 500 mm
<b>Cushioning</b>	P: elastic cushioning rings/pads at both ends	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning, PPV: pneumatic cushioning, adjustable at both ends	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning, PPV: pneumatic cushioning, adjustable at both ends
<b>Description</b>	<ul style="list-style-type: none"> <li>• Mounting hole pattern to ISO 21287</li> <li>• Piston rod can be held or clamped in any position during clamping, processing or handling operations</li> <li>• For position sensing</li> <li>• Piston rod with male or female thread</li> </ul>	<ul style="list-style-type: none"> <li>• Mounting hole pattern to ISO 6432</li> <li>• Piston rod can be held or clamped in any position</li> <li>• Piston rod can be held in position for long periods even with alternating loads, fluctuating operating pressure or leaks in the system</li> <li>• For position sensing</li> </ul>	<ul style="list-style-type: none"> <li>• Piston rod can be held or clamped in any position</li> <li>• Piston rod can be held in position for long periods even with alternating loads, fluctuating operating pressure or leaks in the system</li> <li>• For position sensing</li> </ul>
<b>online:</b> →	<a href="#">adn-kp</a>	<a href="#">dsnu-kp</a>	<a href="#">dsnu-kp</a>

## Rodless cylinders

Type	 Linear drive DGC-K	 Linear drive DGC-G, DGC-GF, DGC-KF	 Linear drive with heavy-duty guide DGC-HD	 Linear drive DGO
<b>Piston diameter</b>	18mm, 25mm, 32mm, 40mm, 50 mm, 63 mm, 80 mm	8mm, 12mm, 18mm, 25mm, 32mm, 40mm, 50mm, 63mm	18mm, 25mm, 40mm	12mm, 16mm, 20mm, 25mm, 32mm, 40mm
<b>Theoretical force at 6 bar, advancing</b>	153 ... 3,016 N	30 ... 1,870 N	153 ... 754 N	68 ... 754 N
<b>Stroke</b>	1 ... 8,500 mm	1 ... 8,500 mm	1 ... 5,000 mm	10 ... 4,000 mm
<b>Cushioning</b>	PPV: pneumatic cushioning, adjustable at both ends	P: elastic cushioning rings/pads at both ends, PPV: pneumatic cushioning, adjustable at both ends, YSR: shock absorber, hard characteristic curve, YSRW: shock absorber, soft characteristic curve	YSR: shock absorber, hard characteristic curve, YSRW: shock absorber, soft characteristic curve	P: elastic cushioning rings/pads at both ends, PPV: pneumatic cushioning, adjustable at both ends
<b>Position sensing</b>	for proximity sensor	for proximity sensor	for proximity sensor	for proximity sensor
<b>Description</b>	<ul style="list-style-type: none"> <li>• Compact design: 30% smaller than basic design DGC-G</li> <li>• Low moving dead weight</li> <li>• Without external guide, for simple drive functions</li> <li>• Easy assembly and installation</li> <li>• Fully interchangeable with the linear drive DGP</li> </ul>	<ul style="list-style-type: none"> <li>• Basic design, plain or recirculating ball bearing guides</li> <li>• Optimised mounting options</li> <li>• High-precision guide</li> <li>• Optimised sealing system</li> <li>• All settings accessible from one side</li> <li>• Available with variable end stops and intermediate position module</li> <li>• Exchangeable with DGPL thanks to foot mountings</li> <li>• Software tool available for bearing calculation</li> <li>• Optional: NSF-H1 lubricant for the food industry</li> <li>• Optional: clamping unit for holding loads</li> </ul>	<ul style="list-style-type: none"> <li>• For maximum loads and torques thanks to duo rail guide</li> <li>• Very good operating behaviour with torque load</li> <li>• Long service life</li> <li>• Ideal as a basic axis for linear gantries and cantilever axes</li> <li>• Excellent price/performance ratio</li> <li>• Wide range of options for mounting on drives</li> </ul>	<ul style="list-style-type: none"> <li>• Magnetic force transmission</li> <li>• Pressure-tight and zero leakage</li> <li>• Dirt-proof and dust-proof</li> </ul>
<b>online:</b> →	<a href="#">dgc-k</a>	<a href="#">dgc</a>	<a href="#">dgc</a>	<a href="#">dgo</a>

## Semi-rotary drives

Type	 Semi-rotary drive DRRD	 Semi-rotary drive DRQD, DRQD-B
<b>Size</b>	16, 20, 25, 32, 35, 40	6, 8, 12, 16, 20, 25, 32, 40, 50
<b>Torque at 6 bar</b>	1.6 ... 24.1 Nm	0.16 ... 78.6 Nm
<b>Swivel angle</b>	180°	0 ... 360°
<b>Permissible mass moment of inertia</b>	0.0175 ... 42 kgm <sup>2</sup>	0.075 ... 11,000 kgcm <sup>2</sup>
<b>Position sensing</b>	for proximity sensor	for proximity sensor
<b>Description</b>	<ul style="list-style-type: none"> <li>• With twin pistons based on the rack and pinion principle</li> <li>• Very high accuracy in the end positions</li> <li>• Very high load bearing capacity</li> <li>• Very good axial run-out at the flanged shaft</li> </ul>	<ul style="list-style-type: none"> <li>• With twin pistons based on the rack and pinion principle</li> <li>• High accuracy</li> <li>• Extremely good rigidity</li> <li>• Wide range of variants</li> <li>• With spigot or flanged shaft</li> </ul>
<b>online:</b> →	<a href="#">drrd</a>	<a href="#">drqd</a>

## Drives with guide rods

Type	 Guided drive DGRF	 Compact cylinder ADNGF	 Guided drive DFM, DFM-B
Piston diameter	20mm, 25mm, 32mm, 40mm, 50mm, 63mm	12mm, 16mm, 20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 80mm, 100mm	12mm, 16mm, 20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 80mm, 100mm
Theoretical force at 6 bar, advancing	189 ... 1,870 N	68 ... 4,712 N	51 ... 4,712 N
Stroke	10 ... 400 mm	1 ... 400 mm	10 ... 400 mm
Cushioning	P: elastic cushioning rings/pads at both ends, PPV: pneumatic cushioning, adjustable at both ends	P: elastic cushioning rings/pads at both ends, PPS: self-adjusting pneumatic end-position cushioning	P: elastic cushioning rings/pads at both ends, PPV: pneumatic cushioning, adjustable at both ends, YSRW: shock absorber, soft characteristic curve
Position sensing	for proximity sensor	for proximity sensor	for proximity sensor
Description	<ul style="list-style-type: none"> <li>• Designed completely to "Clean Design" criteria</li> <li>• Long service life thanks to optional seal for unlubricated operation</li> <li>• FDA-approved lubrication and sealing on the basic version</li> <li>• Good corrosion resistance and smooth surfaces for easy cleaning</li> <li>• Hygienic mounting of the sensors possible</li> <li>• Compact design with high guide precision and load capacity</li> </ul>	<ul style="list-style-type: none"> <li>• Mounting hole pattern to ISO 21287</li> <li>• Piston rod secured against rotation by means of guide rod and yoke plate</li> <li>• Plain-bearing guide</li> <li>• Available with through piston rod</li> </ul>	<ul style="list-style-type: none"> <li>• Drive and guide unit in a single housing</li> <li>• Plain or recirculating ball bearing guides</li> <li>• High resistance to torques and lateral forces</li> <li>• Wide range of mounting options</li> <li>• Wide range of variants</li> </ul>
Suitable for			
online: →	<a href="#">dgrf</a>	<a href="#">adngf</a>	<a href="#">dfm</a>

## Bellows actuators

Type	 Bellows actuators EB
Size	145, 165, 215, 250, 325, 385
Stroke	60 ... 230 mm
Description	<ul style="list-style-type: none"> <li>• Use as a spring element or for reducing oscillations</li> <li>• Single-bellows or double-bellows cylinder</li> <li>• High forces with a short stroke</li> <li>• Uniform movement: no stick-slip effect</li> <li>• Use in dusty environments or in water</li> <li>• Maintenance-free</li> </ul>
online: →	<a href="#">eb</a>

## Fluidic muscle

Type	 Fluidic muscle <b>DMSP</b>	 Fluidic muscle <b>MAS</b>
<b>Size</b>	10, 20, 40	10, 20, 40
<b>Theoretical force at 6 bar</b>	480 ... 6,000 N	480 ... 6,000 N
<b>Nominal length</b>	40 ... 9,000 mm	40 ... 9,000 mm
<b>Max. contraction</b>	25% of nominal length	25% of nominal length
<b>Description</b>	<ul style="list-style-type: none"> <li>• With press-fitted connection</li> <li>• Up to 30% less weight: a superb force/weight ratio</li> <li>• Single-acting, pulling</li> <li>• 3 integrated adapter variants</li> <li>• Ten times the initial force of a comparable pneumatic cylinder</li> <li>• Stick-slip-free movements</li> <li>• Hermetically sealed design offers protection against dust, dirt and moisture</li> </ul>	<ul style="list-style-type: none"> <li>• With screwed connection</li> <li>• Optional with force retention</li> <li>• Single-acting, pulling</li> <li>• Use of customer-specific adaptation options</li> <li>• Ten times the initial force of a comparable pneumatic cylinder</li> <li>• Stick-slip-free movements</li> <li>• Hermetically sealed design offers protection against dust, dirt and moisture</li> </ul>
<b>online:</b> →	<a href="#">dmsp</a>	<a href="#">mas</a>

## Linear actuators for process automation

Type	 Linear actuator with displacement encoder <b>DFPI</b>	 Copac linear actuator <b>DLP</b>
<b>Piston diameter</b>	100mm, 125mm, 160mm, 200mm, 250mm, 320mm	80mm, 100mm, 125mm, 160mm, 200mm, 250mm, 320mm
<b>Theoretical force at 6 bar, advancing</b>	4,712 ... 48,255 N	3,016 ... 48,255 N
<b>Stroke</b>	40 ... 990 mm	40 ... 600 mm
<b>Description</b>	<ul style="list-style-type: none"> <li>• Actuation of linear process valves in process engineering systems</li> <li>• With integrated displacement encoder (potentiometer)</li> <li>• Available with integrated positioning controller and valve block</li> <li>• Sturdy and compact housing with high degree of protection</li> <li>• Ideal for outdoor use thanks to high degree of corrosion resistance</li> <li>• Suitable for use in water, industrial process water and sewage technology, as well as the silage and bulk goods industry</li> <li>• Easy to integrate into an existing control architecture</li> </ul>	<ul style="list-style-type: none"> <li>• Approved in accordance with Directive 94/9/EC (ATEX)</li> <li>• Connection pattern as per NAMUR for solenoid valves to VDI/VDE 3845</li> <li>• Mounting hole pattern to ISO 5210</li> <li>• Piston rod with male thread</li> <li>• For position sensing</li> </ul>
<b>online:</b> →	<a href="#">dfpi</a>	<a href="#">dlp</a>

## Quarter turn actuators for process automation

Type	 Quarter turn actuator DAPS	 Quarter turn actuator DFPB	 Quarter turn actuator Copar DRD, DRE
Torque at nominal operating pressure and 0° swivel angle	8 ... 8,000 Nm	7 ... 945 Nm	
Torque at 6 bar			53.5 ... 8,814 Nm
Swivel angle	90°	90°	90°
Description	<ul style="list-style-type: none"> <li>• High break-away torques</li> <li>• Approved in accordance with Directive 94/9/EC (ATEX)</li> <li>• Flange hole pattern to ISO 5211</li> <li>• Mounting hole pattern to VDI/VDE 3845</li> <li>• Connection pattern as per NAMUR for solenoid valves/sensor boxes to VDI/VDE 3845</li> <li>• Optional with handwheel as manual emergency override</li> <li>• Corrosion-resistant version made from stainless steel</li> </ul>	<ul style="list-style-type: none"> <li>• Identical torque characteristic across the entire rotation angle range of 90°</li> <li>• Process valve connection to ISO 5211 on both sides</li> <li>• Can be mounted on all process valves using pressure relief slot</li> <li>• Mounting hole pattern to VDI/VDE 3845</li> <li>• Sturdy, non-slip and easy-to-clean aluminium housing</li> <li>• Long service life, low wear</li> <li>• Increased corrosion protection</li> </ul>	<ul style="list-style-type: none"> <li>• For automating swivel valves in the process industry</li> <li>• Sturdy and precise</li> <li>• For highly accurate advancing to various positions</li> <li>• Flange hole pattern to ISO 5211</li> <li>• Mounting hole pattern to VDI/VDE 3845</li> <li>• Connection pattern as per NAMUR for solenoid valves/sensor boxes to VDI/VDE 3845</li> </ul>
online: →	<a href="#">daps</a>	<a href="#">dfpb</a>	<a href="#">drd</a>

## Linear drives with displacement encoder

Type	 Standard cylinder with displacement encoder DNCI	 Linear actuator with displacement encoder DGCI	 Linear actuator with displacement encoder DGPI, DGPIL
<b>Piston diameter</b>	32mm, 40mm, 50mm, 63mm	18mm, 25mm, 32mm, 40mm, 63mm	25 mm, 32 mm, 40 mm, 50 mm, 63 mm
<b>Theoretical force at 6 bar, advancing</b>	415 ... 1,870 N	153 ... 1,870 N	295 ... 1,870 N
<b>Max. load, horizontal</b>	45 ... 180 kg	1 ... 180 kg	2 ... 180 kg
<b>Max. load, vertical</b>	15 ... 60 kg	1... 60 kg	10... 60 kg
<b>Stroke</b>	10 ... 2,000 mm	100 ... 2,000 mm	225 ... 2,000 mm
<b>Description</b>	<ul style="list-style-type: none"> <li>Standards-based cylinder to ISO 15552</li> <li>With integrated displacement encoder for relative analogue, contactless measuring</li> <li>Suitable for servopneumatic applications with axis controller CPX-CMAX, SPC200, end-position controller CPX-CMPX, SPC11 and measuring module CPX-CMIX</li> <li>Piston rod variants</li> <li>Piston rod with male thread</li> </ul>	<ul style="list-style-type: none"> <li>With displacement encoder for absolute and contactless measuring</li> <li>Suitable for servopneumatic applications with axis controller CPX-CMAX, SPC200, end-position controller CPX-CMPX, SPC11 and measuring module CPX-CMIX</li> <li>With guide</li> <li>Supply ports alternatively on end face or front</li> </ul>	<ul style="list-style-type: none"> <li>With integrated displacement encoder for absolute and contactless measuring</li> <li>Suitable for servopneumatic applications with axis controller CPX-CMAX, SPC200, end-position controller CPX-CMPX, SPC11 and measuring module CPX-CMIX</li> <li>Available with or without guide</li> </ul>
<b>online:</b> →	<a href="#">dnci</a>	<a href="#">dgci</a>	<a href="#">dgpi</a>

## Linear drives and slide units

Type	 Electric cylinder EPCO	 Electric cylinder ESBF	 Electric cylinder DNCE	 Spindle axis EGC-BS-KF
Size	16, 25, 40	63, 80, 100	32, 40, 63	50, 70, 80, 120, 185
Max. feed force Fx	50 ... 650 N	6000 ... 17,000 N	300 ... 2,500 N	300 ... 3,000 N
Repetition accuracy	+/-0.02 mm	+/-0.01 mm, +/-0.015 mm	+/-0.02 - +/-0.03 mm, +/-0.02 mm, +/-0.07 mm	+/-0.02 mm
Working stroke	50 ... 400 mm	100 ... 400 mm	100 ... 800 mm	50 ... 3000 mm
Description	<ul style="list-style-type: none"> <li>Linear drive with permanently attached motor</li> <li>With recirculating ball spindle</li> <li>Available with female thread</li> <li>Available with holding brake</li> <li>Protection class IP40</li> <li>Compact dimensions</li> <li>Extensive mounting accessories for various installation situations</li> <li>Suitable for simple applications in factory automation that in the past were mostly carried out using pneumatic solutions</li> </ul>	<ul style="list-style-type: none"> <li>With spindle drive</li> <li>Optional: high corrosion protection, protection class IP65, suitable for the food industry, piston rod extension</li> <li>Wide range of accessories</li> </ul>	<ul style="list-style-type: none"> <li>Lead screw or ball screw</li> <li>Standard hole pattern to ISO 15552</li> <li>Available with high corrosion protection</li> <li>Available with lubrication approved for food use</li> <li>Axial or parallel motor mounting</li> <li>Integrated reference switch</li> <li>Freely positionable</li> <li>Non-rotating piston rod</li> <li>Larger strokes available on request</li> </ul>	<ul style="list-style-type: none"> <li>Recirculating ball bearing guide for high loads and torques</li> <li>Available with clamping unit, one or both ends</li> <li>Profile with optimised rigidity</li> <li>High dynamic response and minimum vibration</li> <li>Various spindle pitches</li> <li>Reference switch optional</li> <li>Freely positionable</li> </ul>
Suitable for				
online: →	<a href="#">epco</a>	<a href="#">esbf</a>	<a href="#">dnce</a>	<a href="#">egc-bs</a>

## Linear drives and slide units

Type	 Spindle axis EGC-HD-BS	 Toothed belt axis EGC-TB-KF	 Toothed belt axis EGC-HD-TB	 Toothed belt axis ELGA-TB-G
Size	125, 160, 220	50, 70, 80, 120, 185	125, 160, 220	70, 80, 120
Max. feed force Fx	300 ... 1,300 N	50 ... 2,500 N	450 ... 1,800 N	350 ... 1,300 N
Repetition accuracy	+/-0.02 mm	+/-0.08 mm, +/-0.1 mm	+/-0.08 mm, +/-0.1 mm	+/-0.08 mm
Working stroke	50 ... 2,400 mm	50 ... 8,500 mm	50 ... 5,000 mm	50 ... 8,500 mm
Description	<ul style="list-style-type: none"> <li>With heavy-duty guide</li> <li>With integrated ball screw</li> <li>For maximum loads and torques, high feed forces and speeds and long service life</li> <li>Precise and resilient DUO guide</li> <li>Excellent price/performance ratio</li> <li>Flexible motor connection</li> </ul>	<ul style="list-style-type: none"> <li>Recirculating ball bearing guide for high loads and torques</li> <li>Available with clamping unit, one or both ends</li> <li>Profile with optimised rigidity</li> <li>High dynamic response and minimum vibration</li> <li>Small toothed disc diameter</li> <li>Reference switch optional</li> <li>Freely positionable</li> </ul>	<ul style="list-style-type: none"> <li>With heavy-duty guide</li> <li>For maximum loads and torques, high feed forces and speeds and long service life</li> <li>Precise and resilient DUO guide</li> <li>Excellent price/performance ratio</li> <li>Flexible motor connection</li> </ul>	<ul style="list-style-type: none"> <li>Integrated plain-bearing guide</li> <li>For small and medium loads</li> <li>Minimal guide backlash</li> <li>As an actuator for external guides</li> <li>Speeds up to 5 m/s with high acceleration up to 50 m/s<sup>2</sup></li> <li>Flexible motor connection</li> </ul>
online: →	<a href="#">egc-hd-bs</a>	<a href="#">egc-tb</a>	<a href="#">egc-hd-tb</a>	<a href="#">elga</a>

## Linear drives and slide units

Type	 Toothed belt axis ELGA-TB-RF	 Toothed belt axis ELGG	 Toothed belt axis ELGR	 Cantilever axis DGEA-ZR
Size	70, 80, 120	35, 45, 55	35, 45, 55	18, 25, 40
Max. feed force Fx	350 ... 1,300 N	50 ... 350 N	50 ... 350 N	230 ... 1,000 N
Repetition accuracy	+/-0.08 mm	+/-0.1 mm	+/-0.1 mm	+/-0.05 mm
Working stroke	50 ... 7,400 mm	50 ... 1,200 mm	50 ... 1,500 mm	1 ... 1,000 mm
Description	<ul style="list-style-type: none"> <li>• Integrated roller bearing guide</li> <li>• High speeds up to 10 m/s with high acceleration up to 50 m/s<sup>2</sup></li> <li>• Guide backlash = 0 mm</li> <li>• Very good operating behaviour with torque load</li> <li>• Sturdy alternative for the recirculating ball bearing guide</li> <li>• As an actuator for external guides, especially for high speeds</li> </ul>	<ul style="list-style-type: none"> <li>• For universal use with opposing movement</li> <li>• The different guide variants, the optional long slide and the central support enable solutions that are technically appropriate, reliable and at the same time economical</li> <li>• Long service life of over 2500 km per slide</li> <li>• Easy and reliable sizing with PositioningDrives</li> <li>• Fast and convenient commissioning with the Festo Configuration Tool FCT</li> </ul>	<ul style="list-style-type: none"> <li>• Optimum price/performance ratio</li> <li>• Ready-to-install unit for quick and easy design</li> <li>• High reliability thanks to tested service life of 5,000 km</li> <li>• Motor can be mounted on any one of 4 sides</li> <li>• With plain or recirculating ball bearing guide</li> <li>• Kit for easy and space-saving end-position sensing</li> <li>• Quick commissioning following simple sizing using the PositioningDrives software as well as predefined parameter sets in the parameterisation software FCT</li> </ul>	<ul style="list-style-type: none"> <li>• Toothed belt drive with recirculating ball bearing guide</li> <li>• Dynamic cantilever operation</li> <li>• Stationary drive head</li> <li>• Reference switch optional</li> <li>• Freely positionable</li> </ul>
online: →	<a href="#">elga</a>	<a href="#">elgg</a>	<a href="#">elgr</a>	<a href="#">dgea</a>

## Semi-rotary drives

Type	 Rotary module ERMB
Size	20, 25, 32
Max. driving torque	0.7 ... 8.5 Nm
Max. input speed	900 ... 1,350 rpm
Rotation angle	Infinite
Description	<ul style="list-style-type: none"> <li>• Electromechanical rotary module with toothed belt</li> <li>• Compact design</li> <li>• Mounting interfaces on all sides</li> <li>• Stable arrangement of the output shaft bearings</li> <li>• Unlimited and flexible rotation angle</li> </ul>
online: →	<a href="#">ermb</a>

## Electric handling modules

<b>Type</b>	 <p><b>Rotary/lifting module EHMB</b></p>
<b>Size</b>	20, 25, 32
<b>Max. driving torque</b>	0.7 ... 6.7 Nm
<b>Max. input speed</b>	900 ... 1,350 rpm
<b>Rotation angle</b>	Infinite
<b>Description</b>	<ul style="list-style-type: none"> <li>• Complete module with combined and configurable rotary/lifting movement</li> <li>• Dynamic, flexible, economical thanks to the modular drive concept for the linear movement</li> <li>• Hollow axis with large internal diameter makes laying power supply lines easy, convenient and safe</li> <li>• Extremely short positioning times thanks to high dynamic response during rotation: e.g. 0.25 s when swivelling a 1 kg load by 180°</li> </ul>
<b>online:</b> →	<a href="#">ehmb</a>

## Servo motors

Type	 <b>Motor unit</b> <b>MTR-DCI</b>
Nominal torque	
Nominal rotational speed	3,000 ... 3,400 rpm
Peak torque	
Maximum speed	3,000 ... 3,400 rpm
Description	<ul style="list-style-type: none"> <li>• DC motor with encoder</li> <li>• Gear unit, controller, power electronics integrated</li> <li>• Parameterisation interface RS232</li> <li>• I/O, PROFIBUS, CANopen, PROFIBUS DP, DeviceNet interface</li> <li>• Control panel with display, optional</li> <li>• Gear ratio: 7:1, 14:1, 22:1</li> </ul>
online: →	<a href="#">mtr-dci</a>

## Stepper motors

Type	 <b>Stepper motor</b> <b>EMMS-ST</b>
Maximum speed	430 ... 2,720 rpm
Motor holding torque	0.5 ... 9.3 Nm
Description	<ul style="list-style-type: none"> <li>• 2-phase hybrid technology</li> <li>• Step angle 1.8°</li> <li>• Standard industrial connection technology</li> <li>• Optional: encoder, brake</li> </ul>
online: →	<a href="#">emms-st</a>

## Controllers for AC servo motors

Type	 Motor controller CMMD-AS	 Motor controller CMMS-AS	 Motor controller CMMP-AS, CMMP-AS-M3
Nominal current	8 ... 10 A	4 ... 5 A	2 ... 20 A
Nominal operating voltage AC	230V	230V	230 ... 400 V
Nominal operating voltage phases	1-phase	1-phase	1-phase, 3-phase
Rated output of controller	1,200VA	600VA	500 ... 12,000 VA
Fieldbus coupling	CANopen, DeviceNet, PROFIBUS DP	CANopen, DeviceNet, PROFIBUS DP	CANopen, DeviceNet, Ethernet, Ethernet/IP, PROFIBUS DP, PROFINET, Sercos
Description	<ul style="list-style-type: none"> <li>• Only one piece of controller hardware required to move two servo motors independently of each other</li> <li>• The motor current of 2x 4 A can be distributed between both controllers with a ratio of 2 A: 6 A</li> <li>• Easy and convenient: commissioning and firmware updates via SD card slot</li> <li>• Programming and parameterisation via software tools</li> <li>• Jerk-free and infinite positioning by means of closed-loop operation</li> <li>• Reliable restart blocking for safety-relevant applications</li> </ul>	<ul style="list-style-type: none"> <li>• Digital absolute shaft encoder in single-turn and multi-turn versions</li> <li>• Can be operated as a torque, speed or position controller</li> <li>• Position controller, integrated brake chopper</li> <li>• I/O interface</li> <li>• Electronic gear unit</li> </ul>	<ul style="list-style-type: none"> <li>• Flying saw</li> <li>• For cam disk controllers and highly dynamic movements</li> <li>• Standardised interfaces allow seamless integration in mechatronic multi-axis modular systems</li> <li>• Reliable and convenient commissioning, programming and parameterisation via software tools</li> <li>• Optionally with 3 slots for switch or safety module, for extension module</li> </ul>
online: →	<a href="#">cmmd-as</a>	<a href="#">cmms-as</a>	<a href="#">cmmp-as</a>

## Controllers for stepper motors

Type	 Motor controller CMMO-ST	 Motor controller CMMS-ST
Nominal current	5 A	
Nominal current, load supply	6 A	8A
Max. step frequency		4kHz
Controller operating mode	Cascade controller with PI speed controller, PI current controller, P position controller, PWM MOSFET power end stage	PWM MOSFET power end stage
Fieldbus coupling		CANopen, PROFIBUS DP
Description	<ul style="list-style-type: none"> <li>• As open-loop and closed-loop position controller</li> <li>• Separate load and logic supply</li> <li>• Supports the "Safe Torque Off" (STO) safety function</li> <li>• Easy actuation via I/O interface</li> <li>• Monitoring of freely definable position zones</li> <li>• Backup file enables seamless device replacement</li> </ul>	<ul style="list-style-type: none"> <li>• Can be operated as a torque, speed or position controller</li> <li>• Position controller, integrated brake chopper</li> <li>• I/O interface</li> <li>• Electronic gear unit</li> </ul>
online: →	<a href="#">cmmo-st</a>	<a href="#">cmms-st</a>

## Multi-axis controllers

Type	 Controller CECX-X-M1	 Controller CECX-X-C1	 Controller CMXR-C1	 Controller CMXR-C2
Operating voltage	19.2 ... 30 V DC	19.2 ... 30 V DC	24 VDC +20%/-15%, 24 VDC +25%/-20%	24 VDC +20%/-15%, 24 VDC +25%/-20%
Operating voltage range DC				
Control interface	CAN	CAN		
Fieldbus coupling	TCP/IP, EasyIP, Modbus TCP	TCP/IP, EasyIP, Modbus TCP	2 x CANopen masters	2 x CANopen masters
Supported kinematic systems			2-axis gantries X-Z/Y-Z/X-Y, 3-axis gantries X-Y-Z, any interpolation, parallel kinematic system	2-axis gantries X-Z/Y-Z/X-Y, 3-axis gantries X-Y-Z, any interpolation, parallel kinematic system
Description	<ul style="list-style-type: none"> <li>• Motion controller with CoDeSys and SoftMotion</li> <li>• Programming to standard IEC 61131-3</li> <li>• Three plug-in slots for optional modules</li> <li>• Optional: communication module for PROFIBUS</li> </ul>	<ul style="list-style-type: none"> <li>• Modular master controller with CoDeSys</li> <li>• Programming to standard IEC 61131-3</li> <li>• Three plug-in slots for optional modules</li> <li>• Optional: communication module for PROFIBUS</li> </ul>	<ul style="list-style-type: none"> <li>• Multi-axis control for linear and three-dimensional gantries, parallel kinematic systems</li> <li>• Optional teach pendant CDSA</li> <li>• Point-to-point and complex path control</li> <li>• Ethernet and CAN Bus interface</li> </ul>	<ul style="list-style-type: none"> <li>• Individual integration in higher-order controllers or simple integration of peripheral devices, e.g. tracking function via vision systems by means of integrated CoDeSys PLC</li> <li>• Ideal for bonding or sealing applications: greater process reliability and quality with defined, speed-independent switching points on the path</li> <li>• Increased flexibility: modular control system for digital and analogue I/O optionally expandable</li> </ul>
online: →	<a href="#">cecx</a>	<a href="#">cecx</a>	<a href="#">cmxr-c1</a>	<a href="#">cmxr-c2</a>

## Parallel grippers

Type	 Parallel gripper DHPS	 Parallel gripper HGPLE
<b>Total gripping force at 6 bar, closing</b>	25 ... 910 N	
<b>Stroke per gripper jaw</b>	2 ... 12.5 mm	40mm
<b>Position sensing</b>	For Hall sensor, for proximity sensor	Via integrated angular displacement encoder
<b>Gripping force backup</b>	During closing, during opening	
<b>Description</b>	<ul style="list-style-type: none"> <li>Sturdy and precise T-slot guidance of the gripper jaws</li> <li>High gripping force and compact size</li> <li>Max. repetition accuracy</li> <li>Wide range of options for mounting on drives</li> </ul>	<ul style="list-style-type: none"> <li>Electrically actuated gripper with long stroke</li> <li>Free, speed-controlled selection of gripping positions</li> <li>Long stroke allows use with workpieces of different sizes</li> <li>Adjustable gripping force for highly sensitive and large, heavy workpieces</li> <li>Very high torque resistance, very high accuracy</li> <li>Short opening and closing times</li> <li>Minimal installation costs</li> <li>See product documentation for gripping force on our website</li> </ul>
<b>online: →</b>	<a href="#">dhps</a>	<a href="#">hgple</a>

## Three-point grippers

Type	 Three-point gripper DHDS
<b>Total gripping force at 6 bar, closing</b>	87 ... 750 N
<b>Stroke per gripper jaw</b>	2.5 ... 6 mm
<b>Position sensing</b>	For Hall sensor, for proximity sensor
<b>Gripping force backup</b>	During closing
<b>Description</b>	<ul style="list-style-type: none"> <li>Sturdy and precise T-slot guidance of the gripper jaws</li> <li>High gripping force and compact size</li> <li>Max. repetition accuracy</li> <li>Wide range of options for mounting on drives</li> </ul>
<b>online: →</b>	<a href="#">dhds</a>

## Angle grippers

Type	 <p><b>Angle gripper DHWS</b></p>
Total gripping torque at 6 bar, closing	30 ... 1,362 Ncm
Max. opening angle	40°
Position sensing	For Hall sensor, for proximity sensor
Gripping force backup	During closing
Description	<ul style="list-style-type: none"> <li>• Improved gripper jaw guide</li> <li>• Link guided system</li> <li>• Internal fixed flow control</li> <li>• Max. repetition accuracy</li> <li>• Wide range of options for mounting on drives</li> </ul>
online: →	<a href="#">dhws</a>

## Radial grippers

Type	 <p><b>Radial gripper DHRS</b></p>
Total gripping torque at 6 bar, closing	15 ... 660 Ncm
Max. opening angle	180°
Position sensing	For Hall sensor, for proximity sensor
Description	<ul style="list-style-type: none"> <li>• Lateral gripper jaw support for high torque loads</li> <li>• Self-centring</li> <li>• Gripper jaw centring options</li> <li>• Max. repetition accuracy</li> </ul>
online: →	<a href="#">dhrs</a>

## Bellows grippers

<p>Type</p>	 <p><b>Bellows gripper DHEB</b></p>
<p><b>Bellows stroke</b></p>	<p>3.5 ... 25 mm</p>
<p><b>Min. diameter to be gripped</b></p>	<p>8 ... 66 mm</p>
<p><b>Max. diameter to be gripped</b></p>	<p>11 ... 85 mm</p>
<p><b>Max. operating frequency of gripper</b></p>	<p>0 ... 4 Hz</p>
<p><b>Description</b></p>	<ul style="list-style-type: none"> <li>• 11 sizes for 8 to 85 mm gripping diameter</li> <li>• Upwards or downwards direction of movement of bellows</li> <li>• Different bellows materials EPDM or silicone</li> <li>• Air connection on the side, or from above</li> <li>• Optimised process sequence with increased quality: prevents the workpieces from being scratched</li> <li>• Additional reliability: optional sensing via proximity or position sensor</li> </ul>
<p><b>online:</b> →</p>	<p><a href="#">dheb</a></p>

## Parallel kinematic system, tripod

Type	 <p>Parallel kinematic system, tripod EXPT</p>
Max. effective load	5kg
Working space nominal diameter	450 ... 1,200 mm
Working space nominal height	100mm
Max. picking rate	150 picks/min in 12" cycle
Description	<ul style="list-style-type: none"> <li>• Low moving mass – ideal for high demands on dynamic response in three dimensions</li> <li>• Great path accuracy with a range of path profiles, even for very dynamic operation</li> </ul>
online: →	<a href="#">expt</a>

## Vacuum generators

Type	 Vacuum generator, metric OVEM	 Vacuum generator, pneumatic VN, VN-P, VN-A	 Vacuum generator, electro-pneumatic VN-M, VN-B	 Vacuum generator cartridge VN
Nominal size of laval nozzle	0.45 ... 1.4 mm	0.45 ... 3 mm	0.45 ... 3 mm	0.45 ... 2 mm
Ejector characteristics	standard, high suction rate, high vacuum	In-line, standard, high suction rate, high vacuum	standard, high suction rate, high vacuum	standard, high suction rate, high vacuum
Integrated function	Electric ejector pulse valve, flow control valve, on-off valve, electrical, filter, electric air-saving circuit, non-return valve, open silencer, vacuum switch	Ejector pulse, pneumatic, open silencer, vacuum switch	Ejector pulse, pneumatic, on-off valve, electrical	
Max. vacuum	93%	86 ... 93%	92 ... 93%	92... 93%
Max. suction rate with respect to atmosphere	6 ... 50.5 l/min	6.1 ... 339 l/min	7.2 ... 186 l/min	7.2 ... 184 l/min
Description	<ul style="list-style-type: none"> <li>• Compact design</li> <li>• Monitoring and visualisation of the vacuum by means of vacuum sensor with LCD display</li> <li>• Central electrical connection via an M12 plug</li> <li>• Maintenance-free operation and reduced noise level through an integrated, open silencer</li> <li>• Integrated filter with inspection window for maintenance display</li> <li>• Adjustable ejector pulse</li> </ul>	<ul style="list-style-type: none"> <li>• Can be used directly in the work space</li> <li>• Available as straight type (inline: vacuum port in line with the supply port) or T-shape (standard: vacuum port at 90° to the supply port)</li> <li>• Cost-effective</li> <li>• No wearing parts</li> <li>• Optional with vacuum switch (-P)</li> <li>• Optional with ejector pulse (-A)</li> </ul>	<ul style="list-style-type: none"> <li>• Can be used directly in the work space</li> <li>• Available as straight type (inline: vacuum port in line with the supply port) or T-shape (standard: vacuum port at 90° to the supply port)</li> <li>• Cost-effective</li> <li>• No wearing parts</li> <li>• With solenoid valve for vacuum ON/OFF</li> <li>• Integrated vacuum switch</li> </ul>	<ul style="list-style-type: none"> <li>• For fitting into customised housing for decentralised vacuum generation</li> </ul>
online: →	<a href="#">ovem</a>	<a href="#">vn</a>	<a href="#">vn</a>	<a href="#">vn</a>

## Vacuum gripping technology

Type	 Bernoulli gripper OGGB	 Suction gripper ESG	 Suction cup VAS, VASB
Suction cup size		10x30mm, 15x45 mm, 20x60 mm, 25x75 mm, 30x90 mm, 4x10 mm, 4x20 mm, 6x10 mm, 6x20 mm, 8x20 mm, 8x30 mm	
Suction cup diameter	60 mm, 100 mm, 140 mm	2 ... 200 mm	2 ... 125 mm
Breakaway force at 70% vacuum		0.1 ... 1,610 N	0.14 ... 606 N
Design		oval, standard, round, bellows, 1.5 convolutions, round, bellows, 3.5 convolutions, round, bell-shaped, round, standard, round, extra deep	Vacuum port on top, vacuum port on side, round, bellows, 1.5 convolutions, round, standard,
Information on suction cup materials	POM, NBR	FPM, NBR, PUR, TPE-U(PU), VMQ (silicone)	NBR, PUR, TPE-U(PU), VMQ (silicone)
Description	<ul style="list-style-type: none"> <li>• Ideally suited to transporting thin, extremely delicate and brittle workpieces</li> <li>• Minimised workpiece contact, gentle workpiece handling</li> <li>• Low energy costs thanks to minimised air consumption</li> <li>• Minimal assembly and installation</li> </ul>	<ul style="list-style-type: none"> <li>• Modular system of suction cup holders and suction cups with over 2,000 variants</li> <li>• Available with angle compensator, height compensator, filter</li> <li>• 15 suction cup diameters</li> <li>• 5 suction cup shapes</li> <li>• Suction cup volume: 0.002 ... 245 cm<sup>3</sup></li> <li>• Min. workpiece radius: 10 ... 680 mm</li> <li>• Vacuum port: push-in connector or barbed fitting for plastic tubing, threaded connection</li> </ul>	<ul style="list-style-type: none"> <li>• Sturdy and reliable</li> <li>• Suction cups with fixed connecting thread</li> <li>• 11 suction cup diameters</li> <li>• Round suction cup shape, bellows</li> <li>• Vacuum port on top, at side</li> <li>• Free of copper, PTFE and silicone</li> <li>• Screw-in thread</li> </ul>
Suitable for			
online: →	<a href="#">oggb</a>	<a href="#">esg</a>	<a href="#">vas</a>

## Standard directional control valves

Type	 Standard valve with round plug VSVA-R5, VSVA-R2	 Standard valve with square plug VSVA-C1	 Standard valve for valve terminal VTSA/VTSA-F VSVA-T1	 Pneumatic valve, ISO 15407-1 VSPA
<b>Actuation type</b>	Electric	Electric	Electric	pneumatic
<b>Pneumatic connection 1</b>	Sub-base size 1 to ISO 5599-1, G1/4, Sub-base size 2 to ISO 5599-1, G3/8, Sub-base size 26 mm to ISO 15407-1, sub-base size 01 to VDMA 24563, G1/4, Sub-base size 18 mm to ISO 15407-1, sub-base size 02 to VDMA 24563	Sub-base size 26 mm to ISO 15407-1, Sub-base size 18 mm to ISO 15407-1	Sub-base size 1 to ISO 5599-2, Sub-base size 2 to ISO 5599-2, Sub-base size 18 mm to ISO 15407-2, Sub-base size 26 mm to ISO 15407-2	Sub-base size 18 mm to ISO 15407-1, Sub-base size 26 mm to ISO 15407-1
<b>Standard nominal flow rate</b>	400 ... 2,800 l/min	400 ... 1,100 l/min	400 ... 2,900 l/min	400 ... 1,100 l/min
<b>Valve function</b>	5/2-way, double solenoid, dominant, 5/2-way dominant, 5/2-way, single solenoid, 5/3-way, closed, closed 5/3-way, exhausted, 5/3-way, pressurised, 2x3/2-way, single solenoid, closed, 3/2-way, single solenoid, open/closed, 2x3/2-way, single solenoid, open/closed, 2x3/2-way, single solenoid, open	5/2-way, double solenoid, dominant, 5/2-way dominant, 5/2-way, single solenoid, 5/3-way, closed, closed 5/3-way, exhausted, 5/3-way, pressurised, 2x3/2-way, single solenoid, closed, 2x3/2-way, single solenoid, open/closed, 2x3/2-way, single solenoid, open	5/2-way, single solenoid, 5/2-way, double solenoid, dominant, 5/2-way dominant, 5/3-way, connection 2 pressurised, 4 exhausted, 5/3-way, closed, closed 5/3-way, exhausted, 5/3-way, pressurised 1 to 2, 4 to 5 closed, 5/3-way, pressurised, 2x2/2-way, closed single solenoid, 2x3/2-way, single solenoid, closed, 2x3/2-way, single solenoid, open, 2x3/2-way, single solenoid, open/closed,	2x3/2-way, single solenoid, closed, 2x3/2-way, single solenoid, open, 2x3/2-way, single solenoid, open/closed, 5/2-way, double solenoid, dominant, 5/2-way dominant, 5/2-way, single solenoid, 5/3-way, pressurised, closed 5/3-way, exhausted, 5/3-way, closed
<b>Electrical connection</b>	3-pin, 4-pin, M12x1, M8x1, round design, Central plug	type C, with protective earth conductor, to DIN EN 175301-803, to EN 175301-803, without protective earth conductor	2-pin, 4-pin, to ISO 15407-2, to ISO 5599-2, plug	
<b>Description</b>	<ul style="list-style-type: none"> <li>• High-performance valves in sturdy metal housing</li> <li>• Manifold assembly with mixed sizes possible</li> <li>• Wide range of vertical stacking modules: pressure regulator, flow control plate, vertical pressure shut-off plate, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• High-performance valves in sturdy metal housing</li> <li>• Manifold assembly with mixed sizes possible</li> <li>• Wide range of vertical stacking modules: pressure regulator, flow control plate, vertical pressure shut-off plate, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• High-performance valves in sturdy metal housing</li> </ul>	<ul style="list-style-type: none"> <li>• Sturdy metal design</li> <li>• Manifold assembly with mixed sizes possible</li> <li>• Wide range of vertical stacking modules: pressure regulator, flow control valve, vertical pressure shut-off plate, etc.</li> </ul>
<b>online:</b> →	<a href="#">vsva</a>	<a href="#">vsva</a>	<a href="#">vtsa</a>	<a href="#">iso 15407-1</a>

## Universal directional control valves

				
Type	<b>Solenoid valve VUVG</b>	<b>Solenoid valve VUVB</b>	<b>Solenoid valve CPE10, CPE14, CPE18, CPE24</b>	<b>Solenoid valve VMPA1, VMPA2</b>
Actuation type	Electric	Electric	Electric	Electric
Pneumatic connection 1	G1/4, G1/8, M3, M5, M7	Connecting plate, QS-4, QS-6, QS-8, QS-10	G1/8, G1/4, G3/8, M5, M7, QS-4, QS-6, QS-8, QS-10, QS-12	G1/8, M7
Standard nominal flow rate	80 ... 1,380 l/min	200 ... 1,000 l/min	180 ... 3,200 l/min	360 ... 700 l/min
Valve function	2x3/2-way, single solenoid, closed, 2x3/2-way, single solenoid, open, 2x3/2-way, single solenoid, open/closed, 5/2-way, double solenoid, 5/2-way, single solenoid, 5/3-way, pressurised, closed 5/3-way, exhausted, 5/3-way, closed	3/2-way, closed, single solenoid, 3/2-way, open, single solenoid, 4/2-way, double solenoid, 4/2-way, single solenoid	3/2-way, closed, single solenoid, 3/2-way, open, single solenoid, 5/2-way, double solenoid, 5/2-way, single solenoid, 5/3-way, pressurised, closed 5/3-way, exhausted, 5/3-way, closed	2x2/2-way, closed single solenoid, 2x3/2-way, single solenoid, closed, 2x3/2-way, single solenoid, open, 2x3/2-way, single solenoid, open/closed, 3/2-way, closed, single solenoid, 3/2-way, open, single solenoid, 5/2-way, double solenoid, 5/2-way, single solenoid, 5/3-way, pressurised, closed 5/3-way, exhausted, 5/3-way, closed
Electrical connection	via sub-base, via E-box	type C, socket for multi-pin plug, plug, to EN 175301-803, via sub-base	2-pin, 4-pin, type C, M8x1	4-pin, M8x1, plug
Description	<ul style="list-style-type: none"> <li>• Compact</li> <li>• Easy mounting</li> <li>• Wide choice of variants</li> <li>• High flow rate relative to its size</li> <li>• Individual valve of VG series</li> </ul>	<ul style="list-style-type: none"> <li>• In-line valve</li> <li>• Semi in-line valve</li> <li>• Sub-bases for individual valves</li> <li>• Manifold rail for valve manifold with individual electrical connection or for valve terminal with electrical multi-pin connection</li> </ul>	<ul style="list-style-type: none"> <li>• High flow rate relative to its size</li> <li>• Wide range of functions</li> <li>• Comprehensive valve range</li> </ul>	<ul style="list-style-type: none"> <li>• Supplements the valve terminals MPA</li> <li>• Mounted on individual sub-base</li> <li>• Comprehensive valve range</li> </ul>
online: →	<a href="#">vuvg</a>	<a href="#">vuvb</a>	<a href="#">cpe</a>	<a href="#">vmpa1</a>

## Application-specific directional control valves

Type	 Solenoid valve MHA1, MHP1	 Solenoid valve MHE2, MHP2, MHA2, MHE3, MHP3, MHA3, MHE4, MHP4, MHA4	 Solenoid valve CDVI5.0	 Solenoid valve MHJ9, MHJ10
<b>Actuation type</b>	Electric	Electric	Electric	Electric
<b>Pneumatic connection 1</b>	Sub-base, QS-3, QS-4, prepared for QSP10	Sub-base, G1/4, G1/8, M7, QS-4, QS-6, QS-8	Sub-base	Sub-base, QS-4, QS-6
<b>Standard nominal flow rate</b>	10 ... 30 l/min	90 ... 400 l/min	300 ... 650 l/min	50 ... 160 l/min
<b>Valve function</b>	2/2-way, closed, single solenoid, 2x2/2-way, closed single solenoid, 3/2-way, closed, single solenoid, 3/2-way, open, single solenoid	3/2-way, closed, single solenoid, 3/2-way, open, single solenoid, 5/2-way, single solenoid	2/2-way, closed, single solenoid, 2/2-way, open, single solenoid, 2x3/2-way, single solenoid, closed, 2x3/2-way, single solenoid, open, 3/2-way, closed, single solenoid, 3/2-way, open, single solenoid, 5/2-way, double solenoid, 5/2-way, single solenoid, 5/3-way, pressurised, closed, 5/3-way, exhausted, 5/3-way, closed	2/2-way, closed, single solenoid
<b>Electrical connection</b>	plug	2-pin, cable, plug	10 m cable	2-pin, 3-wire, cable, plug
<b>Description</b>	<ul style="list-style-type: none"> <li>• Semi in-line valve</li> <li>• Sub-base valve</li> <li>• Miniature valve: grid dimension 10 mm</li> <li>• Sub-bases</li> <li>• Manifold block for 2 ... 10 valves</li> <li>• Switching times down to 4 ms</li> <li>• Operating voltage 5, 12 or 24 V DC</li> </ul>	<ul style="list-style-type: none"> <li>• In-line valve</li> <li>• Semi in-line valve</li> <li>• Sub-base valve</li> <li>• Fast-switching valve: switching times down to 2 ms</li> <li>• Direct mounting, individual sub-base, manifold assembly</li> <li>• Manifold block for 2 ... 10 valves</li> <li>• Grid dimension 14, 19, 24 mm</li> <li>• Operating voltage 24 V DC</li> </ul>	<ul style="list-style-type: none"> <li>• Sub-base valve</li> <li>• Corrosion-resistant</li> <li>• Easy-to-clean design</li> <li>• Also available as valve terminal CDVI</li> <li>• Operating voltage 24 V DC</li> </ul>	<ul style="list-style-type: none"> <li>• Sub-base valve</li> <li>• Individual valve with integrated QS fitting</li> <li>• For very fast sorting applications with up to 1,000 Hz</li> <li>• Very long service life &gt; 2 billion switching cycles</li> <li>• Excellent repetition accuracy</li> </ul>
<b>online:</b> →	<a href="#">mh1</a>	<a href="#">mh2</a>	<a href="#">cdvi5.0</a>	<a href="#">mhj9</a>

## One-way flow control valves

				
Type	One-way flow control valve VFOF	One-way flow control valve VFOC	One-way flow control valve GRLA, GRLZ, CRGRLA, GRGA, GRGZ, GRLSA	One-way flow control valve GRXA-HG
Valve function	Exhaust air one-way flow control function	supply air one-way flow control function	Exhaust air one-way flow control function, one-way flow control function, supply air one-way flow control function	Exhaust air one-way flow control function
Pneumatic connection 1	QS-6, QS-8	QS-4, QS-6	G1/8, G1/4, G1/2, G3/8, G3/4, M3, M5, PK-3, PK-3 with union nut, PK-4, PK-4 with union nut, PK-6 with union nut, QS-3, QS-4, QS-6, QS-8, QS-10, QS-12	QS-4, QS-6, QS-8
Standard nominal flow rate in direction of flow control	250 ... 650 l/min	0 ... 270 l/min	0 ... 4,320 l/min	130 ... 280 l/min
Adjusting element	Internal hex	slotted head screw	Knurled screw, slotted head screw	slotted head screw
Description	<ul style="list-style-type: none"> <li>Minimal height</li> <li>High flow rate</li> <li>Can be rotated horizontally through 360° in assembled state</li> <li>Functional combination with one-way flow control valve and piloted non-return valve</li> </ul>	<ul style="list-style-type: none"> <li>Shut-off valve, flow control at one end</li> <li>Metal design</li> <li>Precision adjustment for low and medium speeds</li> <li>Push-in connector/push-in sleeve</li> </ul>	<ul style="list-style-type: none"> <li>Flow control valve, flow control at one end</li> <li>Standard, mini, in-line variants with different flow rates</li> <li>Functional combination with one-way flow control valve and piloted non-return valve</li> <li>Polymer, metal or stainless steel design</li> <li>Connections: thread at both ends, push-in connector at both ends, threaded/push-in connector</li> </ul>	<ul style="list-style-type: none"> <li>Functional combination with one-way flow control valve and piloted non-return valve</li> <li>Holding function and speed setting in one housing</li> <li>Additional supply port for holding crossover interlinking</li> </ul>
online: →	<a href="#">vfof</a>	<a href="#">vfoc</a>	<a href="#">grla</a>	<a href="#">grxa-hg</a>

## Proportional valves

		
Type	Proportional pressure regulator VPPM	Proportional directional control valve VPWP
Valve function	3-way proportional pressure regulator	5/3-way proportional directional control valve, closed
Pneumatic connection 1	Sub-base, G1/8, G1/4, G1/2, NPT1/8-27, NPT1/4-18, NPT1/2-14	G1/4, G1/8, G3/8
Pressure regulation range	0.02 ... 10 bar	0 ... 10 bar
Standard nominal flow rate	380 ... 7,000 l/min	350 ... 2,000 l/min
Description	<ul style="list-style-type: none"> <li>In-line valve</li> <li>Sub-base valve, flanged valve</li> <li>Piloted diaphragm regulator</li> <li>Integration in valve terminal MPA via fieldbus</li> <li>Multi-sensor control</li> <li>High repetition accuracy</li> <li>User interface with LED displays, LCD display, adjustment/selection buttons</li> <li>Setpoint value input as analogue voltage or current signal</li> <li>Integrated pressure sensor</li> <li>Electrical connection via plug, round design, 8-pin, M12 or terminal linking</li> </ul>	<ul style="list-style-type: none"> <li>Controlled piston spool valve</li> <li>Digital actuation</li> <li>Integrated pressure sensors for monitoring function and force control</li> <li>With auto identification</li> <li>Diagnostic function</li> <li>Integrated digital output, e.g. for a clamping/brake unit</li> <li>Suitable for servopneumatic applications with CPX-CMAX and CPX-CMPX</li> </ul>
online: →	<a href="#">vppm</a>	<a href="#">vpwp</a>

## Process/media valves

Type	 Proportional media valve VZQA	 Angle seat valve VZXF	 Solenoid valve VZWD	 Solenoid valve VZWF
<b>Design</b>	Proportional media valve, pneumatically actuated	Poppet valve with spring return	Directly actuated poppet valve	Diaphragm valve, force pilot operated
<b>Valve function</b>	2/2-way, open, monostable	2/2-way, closed, monostable	2/2-way, closed, single solenoid	2/2-way, closed, single solenoid
<b>Standard nominal flow rate</b>	12,800 l/min	3,000 ... 50,700 l/min	60 ... 170 l/min	1,920 ... 29,900 l/min
<b>Flow rate Kv</b>		2.8 ... 47.5 m <sup>3</sup> /h	0.06 ... 0.4 m <sup>3</sup> /h	1.8 ... 28 m <sup>3</sup> /h
<b>Process valve connection</b>	G1/2	G1/2, G3/4, G1, G1 1/4, G1 1/2, G2, NPT 1/2, NPT 3/4, NPT 1, NPT1 1/4, NPT1 1/2, NPT2	G1/8, G1/4	G1/4, G3/8, G1/2, G3/4, G1, G1 1/4, G1 1/2, G2
<b>Actuation type</b>	pneumatic	pneumatic	Electric	Electric
<b>Description</b>	<ul style="list-style-type: none"> <li>The valve can be used to shut off media as well as mixtures of substances</li> <li>Easy-to-clean design</li> </ul>	<ul style="list-style-type: none"> <li>Insensitive to steam or slightly contaminated media</li> <li>No pressure differential required between the input and output</li> <li>Low flow resistance</li> <li>No dead space</li> <li>Long service life</li> <li>Low maintenance</li> </ul>	<ul style="list-style-type: none"> <li>For applications with high pressure ranges and low flow rates</li> <li>Use in vacuum technology</li> <li>For venting gas and tank systems</li> <li>As safety shut-off in burner controllers</li> </ul>	<ul style="list-style-type: none"> <li>Suitable for closed applications such as cooling or filling systems</li> <li>Liquid gas</li> <li>Bottling systems</li> </ul>
<b>Suitable for</b>				
<b>online:</b> →	<a href="#">vzqa</a>	<a href="#">vzxf</a>	<a href="#">vzwd</a>	<a href="#">vzwf</a>

## Process/media valves

Type	 Solenoid valve VZWP	 Ball valve VZBC	 Ball valve actuator unit VZBC	 Ball valve VAPB
<b>Design</b>	Pilot-actuated piston poppet valve, servo controlled	2-way ball valve	2-way ball valve, quarter turn actuator	2-way ball valve
<b>Valve function</b>	2/2-way, closed, single solenoid	2/2	2/2	2/2
<b>Standard nominal flow rate</b>	1,600 ... 12,250 l/min			
<b>Flow rate Kv</b>	1.5 ... 11.5 m <sup>3</sup> /h	19.4 ... 1,414 m <sup>3</sup> /h	19.4 ... 1,414 m <sup>3</sup> /h	5.9 ... 535 m <sup>3</sup> /h
<b>Process valve connection</b>	G1/4, G3/8, G1/2, G3/4, G1	Ring housing with threaded flange	Ring housing with threaded flange	Rp1/4, Rp3/8, Rp1, Rp1 1/4, Rp1 1/2, Rp1/2, Rp3/4, Rp2, Rp2 1/2, Rp3, Rp4
<b>Actuation type</b>	Electric	Mechanical	Pneumatic	Mechanical
<b>Description</b>	<ul style="list-style-type: none"> <li>For all applications with a differential pressure of 0.5 bar</li> <li>For applications with an open medium circuit</li> </ul>	<ul style="list-style-type: none"> <li>Stainless steel, corrosion-resistant</li> <li>Compact design</li> </ul>	<ul style="list-style-type: none"> <li>Stainless steel, corrosion-resistant</li> <li>Compact design</li> </ul>	<ul style="list-style-type: none"> <li>2-way shut-off valve</li> <li>Brass design</li> <li>Actuation via accessories</li> <li>Connecting thread to DIN 2999</li> <li>Mounting flange to ISO 5211</li> <li>Centring attachment for easy automation</li> </ul>
<b>online:</b> →	<a href="#">vzwp</a>	<a href="#">vzbc</a>	<a href="#">vzbc</a>	<a href="#">vapb</a>

## Process/media valves

Type	 Ball valve VZBA	 Ball valve actuator unit VZBA	 Ball valve actuator unit VZPR	 Solenoid valve VZWM
<b>Design</b>	2-way ball valve, 3-way ball valve, L-hole, T-hole	2-way ball valve, 3-way ball valve, L-hole, quarter turn actuator, T-hole	2-way ball valve, quarter turn actuator	Poppet valve with diaphragm seal
<b>Valve function</b>	2/2, 3/2	2/2, 3/2	2/2	2/2-way, closed, single solenoid
<b>Standard nominal flow rate</b>				1,400 ... 31,000 l/min
<b>Flow rate Kv</b>	7 ... 1,414 m <sup>3</sup> /h	7 ... 1,414 m <sup>3</sup> /h	5.9 ... 535 m <sup>3</sup> /h	1.6 ... 39 m <sup>3</sup> /h
<b>Process valve connection</b>	Rp1/4, Rp3/8, Rp1/2, Rp3/4, Rp1, Rp1 1/4, Rp1 1/2, Rp2, Rp2 1/2, Rp3, Rp4, weld-on ends/weld-on ends	Rp1, Rp1 1/2, Rp1 1/4, Rp1/2, Rp1/4, Rp2, Rp2 1/2, Rp3, Rp3/4, Rp3/8, Rp4, weld-on ends/weld-on ends	Rp1/4, Rp3/8, Rp1/2, Rp3/4, Rp1, Rp1 1/4, Rp1 1/2, Rp2, Rp2 1/2	G1/4, G3/8, G1/2, G3/4, G1, G1 1/4, G1 1/2, G2
<b>Actuation type</b>	Mechanical	pneumatic	pneumatic	Electric
<b>Description</b>	<ul style="list-style-type: none"> <li>• 2 or 3-way shut-off valve</li> <li>• Stainless steel design</li> <li>• Actuation via accessories</li> <li>• Connecting thread to DIN 2999 or DIN ISO 228-1</li> <li>• Mounting flange to ISO 5211</li> <li>• Centring attachment for easy automation</li> </ul>	<ul style="list-style-type: none"> <li>• Combination of a pneumatic quarter-turn actuator and a ball valve</li> <li>• Stainless steel design</li> <li>• Connection pattern to Namur VDI/VDE 3845</li> <li>• Flow is fully opened or closed in both directions</li> <li>• Limit switch attachments for end-position sensing can be mounted directly</li> </ul>	<ul style="list-style-type: none"> <li>• Pneumatic double-acting quarter turn actuator and 2-way on-off valve</li> <li>• Flow is fully opened or closed in both directions</li> <li>• Brass or stainless steel design</li> <li>• Connection pattern to Namur VDI/VDE3845</li> </ul>	<ul style="list-style-type: none"> <li>• diaphragm valve</li> <li>• Indirectly actuated</li> <li>• Brass or special steel casting design</li> <li>• Wide range of coils</li> <li>• Electrical connection via solenoid armature tube system 8 or 13</li> <li>• Voltage 24 V DC, 110/230 V AC</li> </ul>
<b>online:</b> →	<a href="#">vzba</a>	<a href="#">vzba</a>	<a href="#">vzpr</a>	<a href="#">vzwm</a>

## Standard valve terminals

Type	 <b>Valve terminal, ISO 15407-2/ISO 5599-2 VTSA</b>
Width	18 mm, 26 mm, 42 mm, 52 mm, 65 mm
Standard nominal flow rate	400 ... 4,000 l/min
Max. no. of valve positions	32
Electrical actuation	Ethernet, fieldbus, multi-pin plug, electrical terminal CPX, integrated controller, individual connection, AS-Interface connection
Valve terminal design	Modular, valve sizes can be mixed
Description	<ul style="list-style-type: none"> <li>Sturdy and flexible valve terminal</li> <li>Widths of 18 mm, 26 mm, 42 mm and 52 mm can be combined on one valve terminal without an adapter</li> <li>Integrated safety functions</li> </ul>
online: →	<a href="#">vtsa</a>

## Universal valve terminals

Type	 <b>Valve terminal with individual electrical connection VTUG</b>	 <b>Valve terminal with multi-pin plug or fieldbus connection VTUG</b>	 <b>Valve terminal VTUB</b>	 <b>Valve terminal MPA-L</b>
Width	10 mm, 14 mm	10 mm, 14 mm	20 mm	10 mm, 14 mm, 20 mm
Standard nominal flow rate	80 ... 780 l/min	130 ... 630 l/min	200 ... 1,000 l/min	0 ... 870 l/min
Max. no. of valve positions	16	24	16	32
Electrical actuation	individual connection	multi-pin plug, I-Port interface, IO-Link, fieldbus,	multi-pin plug, I-Port interface, IO-Link, fieldbus,	fieldbus, multi-pin plug, control block, electrical terminal CPX, IO-Link, I-Port
Valve terminal design	Fixed grid	Fixed grid	Fixed grid	Modular, valve sizes can be mixed
Description	<ul style="list-style-type: none"> <li>Sturdy and durable metal components</li> <li>Connection technology easy to change via the E-box</li> <li>Wide range of valve functions</li> <li>Connection M3, M5, M7, G1/8</li> <li>Push-in connector 3, 4, 6, 8 mm</li> <li>Protection class IP40/IP65</li> </ul>	<ul style="list-style-type: none"> <li>Sturdy and durable metal components</li> <li>Excellent price/performance ratio</li> <li>Connection M5, M7, G1/8</li> <li>Push-in connector 3, 4, 6, 8 mm</li> <li>Protection class IP40/IP67</li> </ul>	<ul style="list-style-type: none"> <li>Outstanding economy</li> <li>Easy to operate</li> <li>Optimised for basic applications</li> </ul>	<ul style="list-style-type: none"> <li>Highly modular and versatile</li> <li>Easily expandable in single steps</li> <li>Plastic sub-bases</li> <li>Protection to IP65</li> </ul>
online: →	<a href="#">vtug-s</a>	<a href="#">vtug</a>	<a href="#">vtub</a>	<a href="#">mpa-l</a>

## Universal valve terminals

Type	 <b>Valve terminal MPA-S</b>	 <b>Valve terminal VTUB-12</b>
Width	10 mm, 20 mm	12 mm, 24 mm
Standard nominal flow rate	0 ... 700 l/min	230 ... 400 l/min
Max. no. of valve positions	64	35
Electrical actuation	fieldbus, multi-pin plug, control block, electrical terminal CPX, AS-interface, CP installation system, individual connection	multi-pin plug, I-Port interface, IO-Link, fieldbus,
Valve terminal design	Modular, valve sizes can be mixed	Fixed grid
Description	<ul style="list-style-type: none"> <li>• Compact dimensions</li> <li>• Two valve sizes can be combined</li> <li>• Strong communication options thanks to serial linking</li> </ul>	<ul style="list-style-type: none"> <li>• Compact dimensions</li> <li>• Sturdy poppet valve</li> <li>• Flexible and low-cost fieldbus modules</li> </ul>
online: →	<a href="#">mpa-s</a>	<a href="#">vtub-12</a>

## Application-specific valve terminals

Type	 <b>Valve terminal CDVI</b>
Width	24 mm
Standard nominal flow rate	300 ... 650 l/min
Max. no. of valve positions	16
Electrical actuation	fieldbus, multi-pin plug,
Valve terminal design	Modular
Description	<ul style="list-style-type: none"> <li>• Hygienic</li> <li>• Corrosion-resistant</li> <li>• Easy to clean (Clean Design)</li> </ul>
Suitable for	
online: →	<a href="#">cdvi</a>

## Electrical peripherals

Type	 Fieldbus module CTEU	 Terminal CPX	 Control block CPX-FEC	 Control block CPX-CEC
<b>Max. no. of inputs</b>	64	Digital 512, analogue 32	512	512
<b>Max. no. of outputs</b>	64	Digital 512, analogue 18	512	512
<b>No. of module positions</b>	32	Max. 9 electric input/output modules	1	
<b>Electrical actuation</b>	CanOpen, DeviceNet, CC-Link, PROFIBUS, EtherCAT, I-Port	Fieldbus, integrated controller	EasyIP, HTTP, Modbus TCP, TCP/IP	CoDeSys level 2, EasyIP, Modbus TCP, TCP/IP
<b>Description</b>	<ul style="list-style-type: none"> <li>• For valve terminals VTUG-12, VTUG, MPA-L, CPV, VTOC</li> <li>• For installation system CTEL</li> <li>• Versatile thanks to protection class IP65/67</li> <li>• Fieldbus-typical LEDs, interfaces and switching elements available</li> <li>• Isolated power supply for electronics and valves</li> <li>• Optional basic diagnostics: undervoltage, short circuit</li> <li>• Optionally expandable for low-cost, decentralised installation of two additional valve terminals with I-Port</li> </ul>	<ul style="list-style-type: none"> <li>• Centralised, decentralised, hybrid installation system with maximum modularity and flexibility</li> <li>• IP65 and IP67 or IP20</li> <li>• Choice of plastic or metal housing with individual linking</li> <li>• Open to common fieldbus protocols and Ethernet</li> <li>• Integrated diagnostics and service function</li> <li>• Operating modes: stand-alone as remote I/O or with valve terminals MPA-S, MPA-L, VTSA/VTSA-F</li> </ul>	<ul style="list-style-type: none"> <li>• Modular I/O system, up to 512 I/Os – full flexibility via CPX</li> <li>• Comprehensive solutions for diagnostics and condition monitoring</li> <li>• Stand-alone open and closed-loop control</li> <li>• Pre-processing with all common fieldbus/Ethernet protocols (remote control) – fast, stand-alone processes on site</li> </ul>	<ul style="list-style-type: none"> <li>• Programming with CoDeSys to IEC 61131-3</li> <li>• Easy actuation of valve terminal configurations with MPA, VTSA</li> <li>• Connection to all fieldbuses as a remote controller and for pre-processing</li> <li>• Diagnostics with flexible monitoring options for pressure, flow rate, cylinder operating time, air consumption</li> <li>• RS232 communication function</li> <li>• Data interface: socket, Sub-D, 9-pin</li> </ul>
<b>online:</b> →	<a href="#">cteu</a>	<a href="#">cpx</a>	<a href="#">cpx-fec</a>	<a href="#">cpx-cec</a>

## Electrical peripherals

				
Type	Control block CPX-CEC-C1	Control block CPX-CEC-M1	Input/output module, input module CPX-L-8DE-8DA, CPX-L-16DE	Output module CPX-FVDA
Max. no. of inputs	512	512	8, 16	
Max. no. of outputs	512	512	8	2
No. of module positions		1		
Electrical actuation	CoDeSys level 2, EasyIP, Modbus TCP, TCP/IP	CoDeSys level 2, EasyIP, Modbus TCP, TCP/IP		Can only be used with PROFINET or PROFIBUS bus nodes
Description	<ul style="list-style-type: none"> <li>• Programming with CoDeSys to IEC 61131-3</li> <li>• Easy actuation of valve terminal configurations with MPA, VTSA</li> <li>• Connection to all fieldbuses as a remote controller and for pre-processing</li> <li>• Diagnostics with flexible monitoring options for pressure, flow rate, cylinder operating time, air consumption</li> <li>• Actuation of electric drives as individual axes via CANopen</li> <li>• Motion functions for electric drives</li> <li>• Fieldbus interface: CAN Bus; up to 31 CANopen slaves can be connected</li> </ul>	<ul style="list-style-type: none"> <li>• Programming with CoDeSys to IEC 61131-3</li> <li>• Easy actuation of valve terminal configurations with MPA, VTSA</li> <li>• Connection to all fieldbuses as a remote controller and for pre-processing</li> <li>• Diagnostics with flexible monitoring options for pressure, flow rate, cylinder operating time, air consumption</li> <li>• Actuation of electric drives as individual axes via CANopen</li> <li>• SoftMotion functions for coordinated multi-axis movements</li> <li>• Fieldbus interface: CAN Bus</li> </ul>	<ul style="list-style-type: none"> <li>• Supports connection blocks with Sub-D, terminal connection and M12 connection</li> <li>• Internal electronic fuse per module</li> <li>• Including interlinking block and connection block with spring-loaded terminals</li> <li>• Status LEDs for each input signal and fault LEDs</li> <li>• Plastic design</li> </ul>	<ul style="list-style-type: none"> <li>• The PROFIsafe shut-off module for interrupting the contact rails of the interlinking block for valves and outputs</li> <li>• Diagnostics: short circuit/overload per channel, undervoltage of valves, cross circuit, wire break per channel</li> </ul>
online: →	<a href="#">cpx-cec-c1</a>	<a href="#">cpx-cec-m1</a>	<a href="#">cpx-l</a>	<a href="#">cpx-fvda</a>

## Electrical peripherals

	
Type	Analogue module CPX-4AE-U-I
Max. no. of inputs	4
Max. no. of outputs	
No. of module positions	
Electrical actuation	
Description	<ul style="list-style-type: none"> <li>• For activating devices with a standardised analogue interface such as pressure switches, temperature, flow rate, filling level, etc.</li> <li>• Supports connection blocks with Sub-D, terminal connection and M12 connection</li> <li>• Supply via interlinking block with voltage for electronics and sensor supply</li> </ul>
online: →	<a href="#">cpx-4ae-u-i</a>

## Proximity sensors, for T-slot

Type	 Proximity sensor SME-8, SME-8M, SME-8-SL, SME-8-FM	 Proximity sensor SMT-8M-A	 Proximity sensor SMT-8F, SMT-8G, SMT-8-SL	 Proximity sensor CRSMT-8
<b>Electrical connection</b>	2-wire, 3-wire, 3-pin, cable, cable with plug, M8x1, snap-on flange, plug, rotatable thread, open end	2-wire, 3-wire, 2-pin, 3-pin, cable, cable with plug, M8x1, M12x1, snap-on flange, rotatable thread	2-wire, 3-wire, 3-pin, cable, cable with plug, M8x1, plug, rotatable thread	3-wire, cable,
<b>Operating voltage range DC</b>	0 ... 230 V	5 ... 30 V	10 ... 30 V	10 ... 30 V
<b>Switching element function</b>	N/O contact, N/C contact	N/C contact, N/C or N/O contact, switchable, N/O contact	Namur, N/O contact	N/O contact
<b>Switching output</b>	contacting, bipolar, without LED function	non-contacting, 2-wire, NPN, PNP, PNP/NPN, switchable	NPN, Namur	PNP
<b>Description</b>	<ul style="list-style-type: none"> <li>Measuring principle: magnetic reed</li> <li>Screw-clamped or clamped in slot, insertable in the slot from above or lengthwise</li> <li>Cable length 0.3, 2.5, 5, 7.5, 0.2 ... 10 m</li> <li>Variant suitable for use with energy chains and robots</li> <li>SME-8-...-S6: heat-resistant design</li> </ul>	<ul style="list-style-type: none"> <li>Short design</li> <li>Measuring principle: magneto-resistive</li> <li>Insertable in the slot from above, does not protrude over the cylinder profile</li> <li>Variant EX2 for use in potentially explosive areas</li> <li>Cable length 0.1 ... 30 m</li> </ul>	<ul style="list-style-type: none"> <li>Measuring principle: magneto-resistive</li> <li>Insertable in the slot lengthwise or from above</li> <li>Type SMT-8-F: in accordance with the ATEX directive for explosive atmospheres</li> <li>Type SMT-8-G: design ideally matched to gripper sensing</li> <li>Type SMT-8-SL: sturdy thanks to long guides and plugs directly at the sensor</li> <li>Cable length 0.3, 2.5 and 5 m</li> <li>Suitable for use with energy chains and robots</li> </ul>	<ul style="list-style-type: none"> <li>Corrosion-resistant design</li> <li>Suitable for the food industry, resistant to acids and cooling lubricants</li> <li>Measuring principle: magneto-resistive</li> <li>Insertable in the slot lengthwise, flush with the cylinder profile</li> <li>Cable length 2.5, 5 m</li> </ul>
<b>Suitable for</b>				
<b>online: →</b>	<a href="#">sme-8</a>	<a href="#">smt-8m</a>	<a href="#">smt-8</a>	<a href="#">smt-8</a>

## Proximity sensors, for T-slot

Type	 Proximity sensor CRSMT-8M
<b>Electrical connection</b>	3-wire, 3-pin, cable, cable with plug, M12x1, M8x1, Rotatable thread
<b>Operating voltage range DC</b>	5 ... 30 V
<b>Switching element function</b>	N/O contact
<b>Switching output</b>	PNP
<b>Description</b>	<ul style="list-style-type: none"> <li>Corrosion-resistant design</li> <li>Suitable for the food industry, resistant to acids and cooling lubricants</li> <li>Measuring principle: magneto-resistive</li> <li>Insertable in the slot lengthwise, flush with the cylinder profile</li> <li>Cable length 2.5, 5 m</li> </ul>
<b>Suitable for</b>	
<b>online: →</b>	<a href="#">smt-8</a>

## Proximity sensors, round design

Type	 Proximity sensor SMEO-4U	 Proximity sensor CRSMEO-4
Electrical connection	2-wire, 3-wire, 3-pin, cable, M8x1, M12x1, plug	3-wire, cable,
Operating voltage range DC	0 ... 250 V	12 ... 30 V
Switching element function	N/O contact	N/O contact
Switching output	Contacting, contacting, bipolar, without LED function	contacting, bipolar,
Description	<ul style="list-style-type: none"> <li>Measuring principle: magnetic reed</li> <li>Cable length 2.5, 5 m</li> <li>U-shaped housing</li> </ul>	<ul style="list-style-type: none"> <li>Corrosion-resistant design</li> <li>Measuring principle: magnetic reed</li> <li>Cable length 2.5 m</li> <li>Straight housing</li> </ul>
Suitable for		
online: →	<a href="#">smeo-4</a>	<a href="#">crsmeo-4</a>

## Proximity sensors, block design

Type	 Proximity sensor SMT-C1
Electrical connection	3-wire, 3-pin, cable, cable with plug, M8x1, M12x1, rotatable thread
Operating voltage range DC	10 ... 30 V
Switching element function	N/O contact
Switching output	PNP
Description	<ul style="list-style-type: none"> <li>Measuring principle: magneto-inductive</li> <li>LED switching status display</li> <li>For Clean Design standard cylinder DSBF with mounting rail for sensors</li> </ul>
Suitable for	
online: →	<a href="#">smt-c1</a>

## Inductive sensors

Type	 Proximity sensor SIEA	 Proximity sensor SIED	 Proximity sensor SIEF	 Proximity sensor SIEH
Size	M8, M12, M18, M30	M12, M18, M30	40x40x65 mm, M8, M12, M18, M30	3mm, M12, M18
Switching output		non-contacting, 2-wire	NPN, PNP	NPN, PNP
Switching element function		N/O contact, N/C contact	Antivalent, N/O contact	N/O contact, N/C contact
Electrical connection	3-pin, 4-pin, M8x1, M12x1, plug	2-wire, 2-pin, cable, M12x1, plug	3-wire, 3-pin, 4-pin, Fixcon, cable, M8x1, M12x1, plug	3-wire, 3-pin, cable, cable with plug, M8x1, M12x1, plug
Operating voltage range DC	15 ... 30 V	10 ... 320 V	10 ... 30 V	10 ... 30 V
Description	<ul style="list-style-type: none"> <li>• With analogue output</li> <li>• Flush mounting</li> <li>• Metric thread</li> </ul>	<ul style="list-style-type: none"> <li>• With standard switching distance</li> <li>• For DC and AC voltage</li> <li>• Metric thread</li> <li>• Flush or non-flush mounting</li> <li>• With switching status display</li> <li>• Design with metal or polyamide housing</li> </ul>	<ul style="list-style-type: none"> <li>• Reduction factor 1 for all metals</li> <li>• Welding field immune</li> <li>• Flush, partially flush or non-flush mounting</li> <li>• With switching status display</li> <li>• Design with housing resistant to welding spatter</li> </ul>	<ul style="list-style-type: none"> <li>• With increased switching distance</li> <li>• Flush mounting</li> <li>• Metric thread</li> <li>• With switching status display</li> <li>• Design with stainless steel housing</li> </ul>
online: →	<a href="#">siea</a>	<a href="#">sied</a>	<a href="#">sief</a>	<a href="#">sieh</a>

## Inductive sensors

Type	 Proximity sensor SIEN	 Proximity sensor SIES	 Proximity sensor SIES-8M
Size	4 mm, 6.5 mm, M5x 0.5, M8x1, M12, M12x1, M18, M18x1, M30, M30x1.5	12x26x40 mm, 15x20x30 mm, 40x40x120 mm, 5x5x25 mm, 8x8x40 mm	T-slot
Switching output	NPN, PNP	NPN, PNP	NPN, PNP
Switching element function	N/O contact, N/C contact	Antivalent, N/O contact, N/C contact	N/O contact, N/C contact
Electrical connection	3-wire, 3-pin, cable, M8x1, M12x1, plug	3-wire, 3-pin, cable, cable with plug, M8x1, screw terminal, plug, rotatable thread	3-wire, 3-pin, cable, cable with plug, M8x1, rotatable thread
Operating voltage range DC	10 ... 30 V	10 ... 30 V	10 ... 30 V
Description	<ul style="list-style-type: none"> <li>• With standard switching distance</li> <li>• For DC voltage</li> <li>• Round design</li> <li>• Metric thread</li> <li>• Flush or non-flush mounting</li> <li>• With switching status display</li> <li>• Design with metal housing</li> <li>• Design with polyamide housing</li> </ul>	<ul style="list-style-type: none"> <li>• Block design</li> <li>• Flush mounting</li> <li>• With switching status display</li> </ul>	<ul style="list-style-type: none"> <li>• Suitable for position sensing for electric axes EGC and grippers with T-slot</li> <li>• With 2 LEDs for better visibility</li> <li>• Flush mounting</li> </ul>
online: →	<a href="#">sien</a>	<a href="#">sies</a>	<a href="#">sies-8m</a>

## Position sensors

Type	 <b>Position transmitter SMAT-8E</b>	 <b>Position transmitter SMAT-8M</b>
Design	For T-slot	For T-slot
Position measuring range	0 ... 50 mm	0 ... 40 mm
Analogue output	0 - 10 V, 0 - 20 mA	0 - 10 V
Electrical connection	4-pin, M8x1, plug	4-pin, cable with plug, M8x1, rotatable thread
Description	<ul style="list-style-type: none"> <li>• Measuring principle: magnetic</li> <li>• Insertable in the slot lengthwise</li> <li>• Current and voltage signal at the analogue output</li> <li>• Variant with cable attributes suitable for use with energy chains and robots</li> <li>• LED status display</li> <li>• Cable length 2.5 m, 5 m</li> </ul>	<ul style="list-style-type: none"> <li>• Measuring principle: magnetic</li> <li>• Insertable in the slot from above, central clamping</li> <li>• Displacement-proportional analogue output signal</li> <li>• Variant with cable attributes suitable for use with energy chains and robots</li> <li>• LED status display</li> <li>• Cable length 0.3 m</li> </ul>
online: →	<a href="#">smat-8e</a>	<a href="#">smat-8m</a>

## Pressure and vacuum sensors

Type	 <b>Drucksensor SPAB</b>	 <b>Pressure sensor SDE1</b>
Pressure measuring range	-1 ... 10 bar	-1 ... 10 bar
Switching element function	Switchable	Switchable,
Pneumatic connection	Male thread G1/8, Male thread NPT1/8-27, Male thread R1/8, Female thread M5	G1/8, QS-4, R1/8, R1/4
Electrical connection	4-wire, 4-pin, cable, M8x1, plug, to EN 60947-5-2, Round design, Square design	3-pin, 4-pin, 5-pin, cable with plug, M8x1, M12x1, plug, to EN 60947-5-2, round design
Display type	Illuminated LCD, multi-colour	Illuminated LCD, back-lit LCD
Description	<ul style="list-style-type: none"> <li>• Relative pressure measurement</li> <li>• Switching output PNP, NPN and analogue output</li> <li>• Two-part, multi-coloured display</li> <li>• Easy commissioning thanks to intuitive operation</li> <li>• Compact design 30x30 mm</li> <li>• Certification: c UL us listed (OL), C-Tick</li> </ul>	<ul style="list-style-type: none"> <li>• Five pressure measuring ranges</li> <li>• Measurement of relative or differential pressure</li> <li>• Switching outputs PNP, NPN and with analogue current or voltage output</li> <li>• LCD or illuminated LCD display</li> <li>• Via H-rail, via wall/surface bracket, mounting on service unit, front panel mounting</li> <li>• Certification: c UL us listed (OL), C-Tick</li> </ul>
online: →	<a href="#">spab</a>	<a href="#">sde1</a>

## Flow sensors

		
<b>Type</b>	<b>Flow sensor SFAB</b>	<b>Flow sensor SFAM</b>
<b>Flow measuring range</b>	0.1 ... 1,000 l/min	10 ... 15,000 l/min
<b>Operating medium</b>	compressed air to ISO 8573-1:2010 [6:4:4], compressed air to ISO 8573-1:2010 [7:4:4], nitrogen	compressed air to ISO 8573-1:2010 [7:4:4], nitrogen
<b>Operating pressure</b>	0 ... 10 bar	0 ... 16 bar
<b>Pneumatic connection</b>	QS-5/16, QS-1/4, QS-3/8, QS-6, QS-8, QS-10, QS-12	Manifold module, G1/2, G1, G1 1/2, NPT1 1/2-11 1/2, NPT1-11 1/2, NPT1/2-14
<b>Electrical connection</b>	5-pin, M12x1, straight plug	5-pin, M12x1, straight plug
<b>Description</b>	<ul style="list-style-type: none"> <li>Flow sensor with integrated digital display</li> <li>With unidirectional flow input</li> <li>Mounting: H-rail mounting, wall or surface mounting</li> <li>Certification: C-Tick</li> </ul>	<ul style="list-style-type: none"> <li>Stand-alone device or combined with MS series service units</li> <li>Supplies absolute flow information and accumulated air consumption measurement</li> <li>Covers large measuring range with specified precision thanks to high dynamic response</li> <li>Large, illuminated LCD display</li> </ul>
<b>online:</b> →	<a href="#">sfab</a>	<a href="#">sfam</a>

## Opto-electronic sensors

				
<b>Type</b>	<b>Sensor SOEG-RT, SOEG-RS</b>	<b>Through-beam sensor SOEG-E, SOEG-S</b>	<b>Fibre-optic unit SOEG-L</b>	<b>Laser diffuse sensor, laser retro-reflective sensor SOEL-RT, SOEL-RS</b>
<b>Method of measurement</b>	Diffuse sensor, retro-reflective sensor, background suppression sensor, diffuse sensor with cylindrical light beam, distance sensor, for transparent objects, laser retro-reflective sensor	Through-beam sensor, receiver, transmitter	Fibre-optic unit	Contrast sensor, background suppression sensor, laser retro-reflective sensor
<b>Working range</b>	0 ... 5,500 mm	0 ... 20,000 mm	0 ... 250 mm	0 ... 20,000 mm
<b>Size</b>	Diameter 4mm, M5, M12x1, M18x1, straight, M18x1, angled, 20x32x12 mm, 30x30x15 mm, 50x50x17 mm	M18x1, straight, M18x1, angled, 20x32x12 mm, 30x30x15 mm, 50x50x17 mm	20x32x12 mm, 30x30x15 mm	20x32x12 mm, 50x50x17 mm
<b>Type of light</b>	Infrared, red, red polarised	Infrared, red	red	Laser, red, red polarised
<b>Switching output</b>	NPN, PNP	NPN, PNP	NPN, PNP	NPN, PNP
<b>Description</b>	<ul style="list-style-type: none"> <li>Round design, block design</li> <li>Setting option: teach-in by means of button and via electrical connection</li> <li>Electrical connection via open cable end or plug</li> </ul>	<ul style="list-style-type: none"> <li>Round design, block design</li> <li>Setting option: potentiometer, teach-in or teach-in via electrical connection</li> <li>Electrical connection via open cable end or plug</li> </ul>	<ul style="list-style-type: none"> <li>Block design</li> <li>Setting option: potentiometer, teach-in, teach-in via electrical connection</li> <li>Electrical connection via open cable end or plug</li> </ul>	<ul style="list-style-type: none"> <li>Setting option: teach-in, teach-in via electrical connection, potentiometer</li> <li>Electrical connection via open cable end or plug</li> </ul>
<b>online:</b> →	<a href="#">soeg-r</a>	<a href="#">soeg-e</a>	<a href="#">soeg-l</a>	<a href="#">soel</a>

## Opto-electronic sensors

Type	 <b>Colour sensor SOEC</b>	 <b>Fork light barrier SOOF</b>
Method of measurement	Colour sensor	Fork light barrier
Working range	12 ... 32 mm	
Size	50x50x17 mm	Fork 120x60 mm, Fork 30x35 mm, Fork 50x55 mm, Fork 80x55 mm
Type of light	White	red
Switching output	PNP	NPN, PNP
Description	<ul style="list-style-type: none"> <li>• Diffuse sensor</li> <li>• Block design</li> <li>• Setting option: teach-in, teach-in via electrical connection</li> <li>• Electrical connection via M12x1 plug, 8-pin</li> <li>• Display via 7 LEDs</li> </ul>	<ul style="list-style-type: none"> <li>• Through-beam sensor with minimal installation effort</li> <li>• Design: polymer or metal</li> <li>• Sturdy housing: high shock and vibration resistance</li> <li>• Protection to IP67</li> <li>• Electrical connection via M8x1 plug, 3-pin</li> <li>• Setting option: potentiometer or teach-in</li> <li>• LED displays</li> </ul>
online: →	<a href="#">soec</a>	<a href="#">soof</a>

## Air gap sensors

Type	 <b>Air gap sensor SOPA</b>
Sensing range	20 ... 200 µm
Operating pressure	4 ... 7 bar
Display type	Illuminated LCD, multi-colour
Operating medium	compressed air to ISO 8573-1:2010 [7:4:4]
Description	<ul style="list-style-type: none"> <li>• Convenient solution for high-precision contact and distance monitoring</li> <li>• Setting option: teach-in or numerical setting using three buttons</li> <li>• Integrated air jet function</li> <li>• Multi-coloured LCD display</li> <li>• H-rail, wall mounting, via through-holes</li> <li>• Certification: C-Tick</li> </ul>
online: →	<a href="#">sopa</a>

## Function monitoring

		
Type	Compact vision system SBOA-M	Compact vision system SBOC-M
Sensor resolution	640 x 480 pixels (VGA)	640 x 480 pixels (VGA)
Working distance	Depends on the lens chosen	Depends on the lens chosen
Field of vision	Depends on the lens chosen	Depends on the lens chosen
Frame rate (full image)	27 ... 241 fps	27 ... 241 fps
Exposure time	1 ... 1,000,000 µs	1 ... 1,000,000 µs
Description	<ul style="list-style-type: none"> <li>Systainer with compact vision system SBOC-M</li> </ul>	<ul style="list-style-type: none"> <li>High-speed camera for diagnostics and commissioning as well as for function monitoring of fast motion sequences</li> <li>Recording and storage electronics integrated in the camera</li> <li>For standard lens with C mount connection</li> <li>Can be networked via Ethernet</li> <li>Compact dimensions, low weight</li> </ul>
online: →	<a href="#">sbox</a>	<a href="#">sbox</a>

## Position and quality inspection

		
Type	Compact vision system SBOC-Q	Compact vision system SBOI-Q
Sensor resolution	1280 x 1024 pixels (SXGA), 640 x 480 pixels (VGA), 752 x 480 pixels (WideVGA)	640 x 480 pixels (VGA), 752 x 480 pixels (WideVGA)
Max. no. of inspection programs	256	256
Frame rate (full image)	27 ... 150 fps	60 ... 150 fps
Lens mounting	CS mount (C mount with lens protection tube)	Integrated lens
Min. part length		
Min. part diameter		
Description	<ul style="list-style-type: none"> <li>Intelligent field-based camera</li> <li>For 2D quality inspection, position and rotary orientation sensing, reading of 1D and 2D codes, reading of optical characters (OCR)</li> <li>Integrated full PLC (CoDeSys)</li> <li>Ethernet and CAN for communicating with higher-level controllers</li> </ul>	<ul style="list-style-type: none"> <li>Intelligent field-based camera</li> <li>For 2D quality inspection, position and rotary orientation sensing, reading of 1D and 2D codes, reading of optical characters (OCR)</li> <li>Integrated full PLC (CoDeSys)</li> <li>Ethernet and CAN for communicating with higher-level controllers</li> </ul>
online: →	<a href="#">sboc-q</a>	<a href="#">sboi-q</a>

## Service unit combinations: MS series

Type	 Service unit combination MSB4, MSB6, MSB9
Pneumatic connection 1	G1/8, G1/4, G1/2, G3/4, G1, G1 1/4, G1 1/2
Standard nominal flow rate	550 ... 18,000 l/min
Pressure regulation range	0.5 ... 16 bar
Operating pressure	0 ... 20 bar
Grade of filtration	0.01 ... 40 µm
Description	<ul style="list-style-type: none"> <li>Sizes: 4, 6, 9</li> <li>Combination of filter regulator MS-LFR, filter MS-LF, fine and micro filter MS-LFM, activated carbon filter MS-LFX, pressure regulator MS-LR, MS-LRB, precision pressure regulators MS-LRP, MS-LRPB, electric pressure regulator MS-LRE, lubricator MS-LOE, on-off valves MS-EM, MS-EE, soft-start valves MS-DL, MS-DE, soft-start/quick exhaust valve MS-SV, membrane air dryer MS-LDM1</li> </ul>
online: →	<a href="#">msb4</a>

## On-off and soft-start valves: MS series

Type	 Soft-start/quick exhaust valve MS6-SV-E	 Soft-start/quick exhaust valve MS6-SV-C, MS9-SV-C
Pneumatic connection 1	Connecting plate G1/2	Connecting plate, G1/2, G3/4, G1
Standard nominal flow rate	4,300 l/min	5,700 l/min, 14,150 ... 16,460 l/min
Operating pressure	3.5 ... 10 bar	3 ... 18 bar, 3.5 ... 16 bar
Actuation type	Electric	Electric
Description	<ul style="list-style-type: none"> <li>Performance level: category 4, 2-channel with self-monitoring, to EN ISO 13849-1</li> <li>SIL 3</li> <li>For reducing pressure quickly and reliably and for building up pressure gradually</li> <li>Switching time delay adjustable via a flow control valve for gradual pressure build-up</li> <li>Available with silencer</li> <li>Supply voltage 24 V DC</li> <li>Size 6</li> <li>Grid dimension 62 mm</li> </ul>	<ul style="list-style-type: none"> <li>Performance level: category 1, to EN ISO 13849-1</li> <li>For reducing pressure quickly and reliably and for building up pressure gradually</li> <li>Switching time delay adjustable via a flow control valve for gradual pressure build-up</li> <li>Supply voltage 24 V DC</li> <li>Size 6, 9</li> <li>Grid dimension 62, 90 mm</li> </ul>
online: →	<a href="#">ms6-sv</a>	<a href="#">ms6-sv-c</a>

## Air dryers: Individual devices

Type	 <p><b>Adsorption dryer PDAD</b></p>
Pneumatic connection 1	G3/8, G1/2
Standard nominal flow rate	10 ... 1,000 l/min
Supply pressure 1	4 ... 16 bar
Pressure dew point	-40°C or -70°C
Description	<ul style="list-style-type: none"> <li>• Ideal for decentralised compressed air drying</li> <li>• Extends the service life of pneumatic components</li> <li>• Additional filtering of oil and particulates</li> <li>• Defined pressure dew point</li> <li>• High flow rate</li> <li>• Low purge air consumption and noise levels</li> </ul>
online: →	<a href="#">pdad</a>

## Pressure boosters

Type	 <p><b>Pressure booster DPA</b></p>
Pneumatic connection 1	G1/4, G3/8, G1/2
Output pressure 2	4 ... 16 bar
Supply pressure 1	2 ... 10 bar
Description	<ul style="list-style-type: none"> <li>• Minimal loss of volume due to valve activation</li> <li>• Designed as a pressure booster/air reservoir combination</li> <li>• Any mounting position</li> <li>• Short filling times</li> <li>• Long service life</li> <li>• Compact design</li> <li>• Available with sensing option</li> </ul>
online: →	<a href="#">dpa</a>

## Standard O.D. tubing

Type	 Plastic tubing, DUO tubing PUN-H, PUN-H-DUO	 Plastic tubing PLN	 Plastic tubing PFAN
O.D.	2 ... 16 mm	4 ... 16 mm	4 ... 12 mm
I.D.	1.2 ... 11 mm	2.9 ... 12 mm	2.9 ... 8.4 mm
Temperature-dependent operating pressure	-0.95 ... 10 bar	-0.95 ... 14 bar	-0.95 ... 16 bar
Ambient temperature	-35 ... 60 °C	-30 ... 80 °C	-20 ... 150 °C
Description	<ul style="list-style-type: none"> <li>• Polyurethane</li> <li>• Also in the form of DUO plastic tubing</li> <li>• Operating medium: compressed air, vacuum</li> <li>• Approved for use in the food industry</li> <li>• High resistance to microbes and hydrolysis</li> <li>• Suitable for use with energy chains</li> </ul>	<ul style="list-style-type: none"> <li>• High resistance to chemicals, microbes, hydrolysis</li> <li>• Approved for use with food</li> <li>• Resistant to most cleaning agents and lubricants</li> <li>• Operating medium: compressed air, vacuum, water</li> <li>• Polyethylene</li> <li>• RoHS-compliant</li> </ul>	<ul style="list-style-type: none"> <li>• Pneumatic tubing with resistance to high temperatures and chemicals</li> <li>• Approved for use with food</li> <li>• High resistance to chemicals, microbes, UV radiation, hydrolysis, stress cracks</li> <li>• Perfluoroalkoxy alkane</li> <li>• RoHS-compliant</li> <li>• Operating medium: compressed air, vacuum</li> </ul>
Suitable for			
online: →	<a href="#">pun-h</a>	<a href="#">pln</a>	<a href="#">pfan</a>

## Push-in fittings

Type	 Push-in fitting QS, QSF, QSS, QSSF, QSC, QSH, QSL, QSL, QSLF, QSLV, QST, QSTF, QSTL, QSW, QSX, QSY, QSYL, QSYLV, QSYTF	 Push-in fitting QS-B, QSL-B, QSL-B, QST-B, QSTL-B, QSY-B	 Push-in fitting NPQM	 Click fitting NPKA
<b>Pneumatic connection</b>	Male thread G1/8, G1/4, G3/8, G1/2, M5, R1/8, R1/4, R1/2, R3/8, female thread G1/8, G1/8, G3/4, G1/2, push-in sleeve QS-4, QS-6, QS-8, QS-10, QS-12, QS-16, for tubing O.D. 4, 6, 8, 10, 12, 16 mm	male thread R1/8, R1/4, R3/8, R1/2, for tubing O.D. 4, 6, 8, 10, 12, 16 mm	G1/8, G1/4, G3/8, G1/2, M5, M7, push-in sleeve QS-4, QS-6, QS-8, QS-10, QS-12, for tubing O.D. 8, 10, 12, 4, 6 mm	Male thread G1/8
<b>Pneumatic connection, outlet</b>	female thread G1/8, G1/8, G3/4, G1/2, for tubing O.D. 4, 6, 8, 10, 12, 16 mm	for tubing O.D. 4, 6, 8, 10, 12, 16 mm	for tubing O.D. 3, 4, 6, 8, 10, 12 mm	for tubing O.D. 6 mm
<b>Operating pressure</b>			-0.95 ... 16 bar	-0.95 ... 10 bar
<b>Temperature-dependent operating pressure</b>	-0.95 ... 14 bar	-0.95 ... 10 bar		-0.95 ... 10 bar
<b>Ambient temperature</b>	-10 ... 80 °C	-10 ... 60 °C	-20 ... 70 °C	-10 ... 60°C
<b>Description</b>	<ul style="list-style-type: none"> <li>• Quick Star, standard</li> <li>• Male or female thread with external or internal hex</li> <li>• Wide range of variants: wide selection for maximum flexibility in standard applications</li> <li>• Resistant to pressure: economical for pneumatic installations in the high-pressure range</li> </ul>	<ul style="list-style-type: none"> <li>• Quick Star, standard</li> <li>• Male thread with external or internal hex</li> <li>• Economical, universal application and attractively priced</li> <li>• High resistance</li> <li>• Easy to install</li> </ul>	<ul style="list-style-type: none"> <li>• Quick Star, standard</li> <li>• Attractively priced metal push-in fitting</li> <li>• Male or female thread with external or internal hex</li> </ul>	<ul style="list-style-type: none"> <li>• No nominal diameter reduction as the tubes are held externally</li> <li>• Low leakage as no retaining claws</li> <li>• Assembly and dismantling without tools</li> <li>• Simple and fast to install</li> <li>• Suitable for vacuum</li> </ul>
<b>Suitable for</b>				
<b>online: →</b>	<a href="#">qs</a>	<a href="#">qs-b</a>	<a href="#">npqm</a>	<a href="#">npka</a>

## Push-in fittings

Type	 Push-in fitting, push-in connector NPQH	 Push-in fitting NPQP	 Fitting NPCK	 Push-in fitting CRQS, CRQSL, CRQSS, CRQST, CRQSY
<b>Pneumatic connection</b>	Male thread M5, M7, G1/8, G1/4, G3/8, G1/2, for tubing O.D. 4 mm, 6 mm, 8 mm, 10 mm, 12 mm, 14 mm, Female thread G1/8, G1/4	Male thread R1/8, R1/4, R3/8, R1/2, push-in sleeve QS-4, QS-6, QS-8, QS-10, QS-12, for tubing O.D. 8, 10, 12, 4, 6 mm	Male thread G1/8, G1/4, G3/8,	Male thread M5, R1/8, R1/4, R3/8, R1/2, for tubing O.D. 4, 6, 8, 10, 12, 16 mm
<b>Pneumatic connection, outlet</b>	for tubing O.D. 4 mm, 6 mm, 8 mm, 10 mm, 12 mm, 14 mm		for tubing O.D. 6 mm, 8 mm, 10 mm	for tubing O.D. 4, 6, 8, 10, 12, 16 mm
<b>Operating pressure</b>		-0.95 ... 10 bar	-0.95 ... 12 bar	-0.95 ... 10 bar
<b>Temperature-dependent operating pressure</b>			-0.95 ... 12 bar	
<b>Ambient temperature</b>	-0.95 ... 16 bar	-20 ... 60 °C	-20 ... 120°C	-15 ... 120 °C
<b>Description</b>	<ul style="list-style-type: none"> <li>Resistant to pressure</li> <li>All metal push-in fitting made of chemically nickel-plated brass</li> <li>High corrosion and chemical resistance</li> </ul>	<ul style="list-style-type: none"> <li>Low-cost alternative to stainless steel: resistant to most cleaning agents in combination with tubing PLN</li> <li>Polypropylene fitting for use in applications with extreme influence of media</li> <li>Suitable for use with food</li> </ul>	<ul style="list-style-type: none"> <li>Made entirely from stainless steel</li> <li>Fulfils all Clean Design requirements</li> <li>Suitable for use in cleaning-intensive areas</li> </ul>	<ul style="list-style-type: none"> <li>Quick Star, stainless steel</li> <li>Maximum corrosion resistance (corrosion resistance class 4 to Festo standard 940 070) and chemical resistance</li> <li>Approval for use in the food and beverage industry</li> <li>Male thread with internal and external hex</li> </ul>
<b>Suitable for</b>				
<b>online:</b> →	<a href="#">npqh</a>	<a href="#">npqp</a>	<a href="#">npck</a>	<a href="#">crqs</a>

## Electronic controllers

	
Type	Controller CECC-D, CEDD-LK
Operating voltage	19.2 ... 30 V DC
CPU data	400 MHz processor
Type of fieldbus interface	CAN
Ethernet, connector plug	RJ45
Description	<ul style="list-style-type: none"> <li>• Modern, compact and versatile controller</li> <li>• Programming with CoDeSys to IEC 61131-3</li> <li>• 12 digital inputs, 8 digital outputs, 2 high-speed counters up to 250 kHz</li> <li>• Ethernet 10/100 Mbit/s</li> <li>• USB interface for data transfer</li> <li>• CECC-LK with CANopen, IO-Link, I-Port and Modbus TCP-protocol</li> </ul>
online: →	<a href="#">cecc</a>

## Electrical peripherals

				
Type	Terminal CPX-P	Fieldbus module CTEU	Terminal CPX	Electrical interface CPX-CTEL
Max. no. of inputs	64	64	Digital 512, analogue 32	256
Max. no. of outputs	64	64	Digital 512, analogue 18	256
No. of module positions	Max. 9 electrical	32	Max. 9 electric input/output modules	Max. 4 modules with I-Port interface
Electrical actuation	fieldbus, integrated controller,	CanOpen, DeviceNet, CC-Link, PROFIBUS, EtherCAT, I-Port	Fieldbus, integrated controller	I-Port
Description	<ul style="list-style-type: none"> <li>• Use of harmonised remote I/O and valve terminals in a control cabinet</li> <li>• Unique modular structure</li> <li>• Comprehensive integrated diagnostic and maintenance functions</li> <li>• Combination with modules of the electrical terminal CPX, which enables use for hybrid applications</li> <li>• IP65</li> </ul>	<ul style="list-style-type: none"> <li>• For valve terminals VTUB-12, VTUB, VTUG, MPA-L, CPV</li> <li>• Versatile thanks to protection class IP65/67</li> <li>• Fieldbus-typical LEDs, interfaces and switching elements available</li> <li>• Isolated power supply for electronics and valves</li> <li>• Optional basic diagnostics: undervoltage, short circuit</li> <li>• Optionally expandable for low-cost, decentralised installation of two additional valve terminals with I-Port</li> </ul>	<ul style="list-style-type: none"> <li>• Centralised, decentralised, hybrid installation system with maximum modularity and flexibility</li> <li>• IP65 and IP67 or IP20</li> <li>• Choice of plastic or metal housing with individual linking</li> <li>• Open to common fieldbus protocols and Ethernet</li> <li>• Integrated diagnostics and service function</li> <li>• Operating modes: stand-alone as remote I/O or with valve terminals MPA-S, MPA-L, VTSA/VTSA-F</li> </ul>	<ul style="list-style-type: none"> <li>• Cost-effective: fieldbus connection for the price of a multi-pin interface</li> <li>• Decentral input modules and valve terminals with short tubing, short cycle times and low energy consumption combined with CPX terminal</li> <li>• Standardised M12 connections reduce cost, installation time and logistics complexity</li> </ul>
online: →	<a href="#">cpx</a>	<a href="#">cteu</a>	<a href="#">cpx</a>	<a href="#">cpx-ctel</a>

## Operator units, with touchscreen

		
<b>Type</b>	<b>Operator unit CDSA</b>	<b>Operator unit CDPX</b>
<b>Display</b>	Colour TFT	Colour TFT
<b>Display size</b>	6.5"	4.3", 7", 10.4", 13.3"
<b>Display resolution</b>		WQVGA, 480x272 pixels, WVGA, 800x480 pixels, SVGA, 800x600 pixels, WXGA, 1280x800 pixels
<b>Ethernet interface</b>	2nd Ethernet interface optional, 10 MBd, RJ45 10/100 MBd	RJ45 10/100 MBd
<b>No. of function keys</b>	31	
<b>Description</b>	<ul style="list-style-type: none"> <li>• Interfaces for Ethernet, RS-422-A/RS-232-C, USB host/USB client</li> <li>• Designs with colour touch screen</li> </ul>	<ul style="list-style-type: none"> <li>• Powerful processors combined with wide-screen technology</li> <li>• Remote access, remote control</li> <li>• FTP and HTTP servers</li> <li>• Open for WEB and multimedia applications</li> </ul>
<b>online:</b> →	<a href="#">cdsa</a>	<a href="#">cdpx</a>

## Documentation

	
<b>Type</b>	<b>Manuals and descriptions</b> GDCW, GDCP, GDCC, GSIB, P.BE, P.BP
<b>Description</b>	<ul style="list-style-type: none"> <li>• For software</li> <li>• For control blocks</li> <li>• For motors and controllers</li> <li>• For valve terminals and electrical peripherals</li> <li>• For vision systems</li> </ul>
<b>online:</b> →	<a href="#">dokumentationen</a>

## Control cabinets

			
<b>Type</b>	Factory automation	Process automation	Control cabinets for controllers
<b>Technical data</b>	<ul style="list-style-type: none"> <li>• Simple to complex control cabinet designs</li> <li>• Application-specific combination of components</li> <li>• Fully tested, with test certificate</li> <li>• Ready-to-install</li> <li>• Complete documentation</li> <li>• Design conforms to:                             <ul style="list-style-type: none"> <li>– EN 60204-1</li> <li>– ATEX zone 1 and 21 (pneumatic only), ATEX zone 2 and 22 (electric and electro-pneumatic)</li> <li>– UL-508A</li> </ul> </li> <li>• Implementation of safety functions</li> <li>• Different bus technologies</li> </ul>	<ul style="list-style-type: none"> <li>• Simple to complex control cabinet designs</li> <li>• Application-specific combination of components</li> <li>• Different operating voltages</li> <li>• Fully tested, with test certificate</li> <li>• Ready-to-install</li> <li>• Complete documentation</li> <li>• Design conforms to:                             <ul style="list-style-type: none"> <li>– EN 60204-1</li> <li>– ATEX zone 1 and 21 (pneumatic only), ATEX zone 2 and 22 (electric and electro-pneumatic)</li> <li>– UL-508A</li> </ul> </li> <li>• Implementation of safety functions</li> <li>• Wide range of bus technologies</li> <li>• Compliance with special cleanliness and hygiene requirements</li> <li>• Special materials</li> <li>• Protected against the ingress of liquids and foreign matter</li> <li>• Heating or cooling elements</li> <li>• Intrinsically safe valve terminal technology</li> <li>• Hot swap inspection window</li> </ul>	<ul style="list-style-type: none"> <li>• Simple to complex control cabinet designs</li> <li>• 1 ... 31 axes</li> <li>• Application-specific combination of components</li> <li>• Use of the latest innovations and technologies</li> <li>• Fully tested, with test certificate</li> <li>• Ready-to-install</li> <li>• Complete documentation</li> <li>• Design conforms to:                             <ul style="list-style-type: none"> <li>– EN 60204-1</li> <li>– ATEX zone 1 and 21 (pneumatic only), ATEX zone 2 and 22 (electric and electro-pneumatic)</li> <li>– UL-508A</li> </ul> </li> <li>• Implementation of safety functions</li> <li>• Wide range of bus technologies</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>• Control cabinets made to measure</li> <li>• Pneumatic, electric, combined</li> <li>• Individually configured</li> <li>• Adapted to requirements in industrial automation</li> <li>• Design and sizing included</li> </ul>	<ul style="list-style-type: none"> <li>• Control cabinets made to measure</li> <li>• Pneumatic, electric, combined</li> <li>• Individually configured</li> <li>• Adapted to requirements in process automation</li> <li>• Design and sizing included</li> </ul>	<ul style="list-style-type: none"> <li>• Made-to-measure control cabinets for handling systems</li> <li>• Software package for third-party devices included</li> <li>• Individually configurable</li> <li>• Adapted to requirements for handling solutions</li> </ul>
<b>Online:</b>	<a href="#">Ready-to-install</a>	<a href="#">Ready-to-install</a>	<a href="#">Ready-to-install</a>

## Mounting plates and assemblies

		
<b>Type</b>	Mounting plates	Assemblies
<b>Technical data</b>	<ul style="list-style-type: none"> <li>• Customised shape</li> <li>• Support plate in different materials</li> <li>• Application-specific combination of components</li> <li>• Fully assembled, connected and wired</li> <li>• Defined interfaces</li> <li>• Ready-to-install</li> <li>• Fully tested, with test certificate</li> <li>• Complete documentation</li> <li>• Design conforms to:                             <ul style="list-style-type: none"> <li>– EN 60204-1</li> <li>– ATEX zone 1 and 21 (pneumatic only), ATEX zone 2 and 22 (electric and electro-pneumatic)</li> <li>– UL-508A</li> </ul> </li> <li>• Implementation of safety functions</li> </ul>	<ul style="list-style-type: none"> <li>• Combination of various pneumatic and/or electrical components to create a single unit</li> <li>• Application-specific combination of components</li> <li>• Accessories mounted on sub-assembly</li> <li>• Use of the latest innovations and technologies</li> <li>• Ready-to-install</li> <li>• Fully tested, with test certificate</li> <li>• Complete documentation</li> <li>• Design conforms to:                             <ul style="list-style-type: none"> <li>– EN 60204-1</li> <li>– ATEX zone 1 and 21 (pneumatic only), ATEX zone 2 and 22 (electric and electro-pneumatic)</li> <li>– UL-508A</li> </ul> </li> <li>• Implementation of safety functions</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>• Machine-specific pre-assembly of pneumatic and electrical components on support plate</li> <li>• Tubing and wiring included</li> <li>• Defined interfaces for simple installation directly in the system</li> </ul>	<ul style="list-style-type: none"> <li>• Pneumatic and electrical components pre-assembled to create a function unit</li> <li>• Can be combined from around 30,000 catalogue components</li> <li>• Connections included</li> <li>• For integration in machines</li> </ul>
<b>Online:</b>	<a href="#">Ready-to-install</a>	<a href="#">Ready-to-install</a>

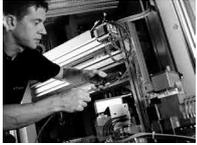
## Integration solutions

Type	 Manifold duct plates	 Cartridge solutions	 Sheet-metal constructions and special housings	 Function blocks
<b>Technical data</b>	<ul style="list-style-type: none"> <li>• Freely selectable manifold duct plate shape</li> <li>• Combination of over 30,000 catalogue components</li> <li>• High density of components</li> <li>• No tubing</li> <li>• Variable positioning of mechanical, pneumatic and electrical interfaces</li> <li>• Integration of customised components</li> <li>• Available with protective cover</li> <li>• Fully tested</li> <li>• Ready-to-install</li> <li>• Complete documentation</li> <li>• Implementation of safety functions</li> </ul>	<ul style="list-style-type: none"> <li>• Space-saving thanks to extremely compact design</li> <li>• Pneumatic functions integrated in a single compact housing</li> <li>• Housing in different materials</li> <li>• No tubing required</li> <li>• Minimal cabling required</li> <li>• Significant design freedom</li> <li>• Variable integration options on and within the machine</li> <li>• Sturdy design</li> <li>• Fully tested</li> <li>• Ready-to-install</li> <li>• Complete documentation</li> </ul>	<ul style="list-style-type: none"> <li>• Sheet-metal constructions                             <ul style="list-style-type: none"> <li>– Customised shape and size</li> <li>– Reduced weight and number of assembly parts</li> </ul> </li> <li>• Special housing                             <ul style="list-style-type: none"> <li>– Customised shape</li> <li>– Customised dimensions</li> <li>– Various materials</li> <li>– Compact, space-optimised format</li> <li>– Protection against environmental influences and unauthorised access</li> </ul> </li> <li>• In combination                             <ul style="list-style-type: none"> <li>– Alternative to conventional control cabinets</li> <li>– Variable integration options on and within the machine</li> <li>– Short tubing and cable lengths</li> <li>– Attractive design</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• No tubing required thanks to drilled ducts</li> <li>• Housing available in different materials</li> <li>• Customised design of the pneumatic interfaces for the system</li> <li>• Ideal for a small number of components and variable connection options</li> <li>• Extremely economical, even for small quantities</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>• Ideal for a large number of pneumatic connections in an extremely compact space</li> <li>• No tubing</li> <li>• Compact</li> <li>• Easy to service</li> <li>• Immune to malfunction</li> </ul>	<ul style="list-style-type: none"> <li>• Integration of various pneumatic functions in one component</li> <li>• No need for single housings</li> <li>• Ideal for applications that require a highly compact design</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced weight thanks to optimal use of materials with sheet-metal constructions</li> <li>• Protection against environmental influences and unauthorised access</li> <li>• Ideally combined as a control cabinet directly in the system</li> </ul>	<ul style="list-style-type: none"> <li>• Compressed air supply for pneumatic components via drilled ducts</li> <li>• Ideal for a small number of pneumatic components and variable connection options</li> <li>• Compact and easy to service</li> </ul>
<b>Online:</b>	<a href="#">Ready-to-install</a>	<a href="#">Ready-to-install</a>	<a href="#">Ready-to-install</a>	<a href="#">Ready-to-install</a>

## Integration solutions

Type	 Profile solutions
<b>Technical data</b>	<ul style="list-style-type: none"> <li>• Profiles in customised cross sections and lengths</li> <li>• Integrated ducts for straight-line routing of the compressed air</li> <li>• Common air supply for multiple valves or valve terminals via a single duct</li> <li>• Combination of exhaust air and supply air without tubing, even over long distances</li> <li>• Supply of compressed air at different locations</li> <li>• No tubing required</li> <li>• Significantly reduced cabling</li> <li>• Modular, easy to realise construction</li> <li>• Optional: profile as mechanical mounting element for other components or as a supporting part of the machine frame</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>• Extruded profiles in combination with valves as a valve terminal</li> <li>• For the distribution of compressed air in the machine concept</li> <li>• Customised profile cross sections available</li> </ul>
<b>Online:</b>	<a href="#">Ready-to-install</a>

## Operating phase

	<p>Maintenance</p>		<p>Repair service</p>
<p><b>Services</b></p>	<p>Implementation of the following preventive maintenance measures to DIN 31051:</p> <ul style="list-style-type: none"> <li>• Inspections                             <ul style="list-style-type: none"> <li>– Checking for damage and wear characteristics</li> <li>– Checking of mechanical, pneumatic and electrical connections and connectors</li> <li>– Checking of lubrication</li> <li>– Checking of compressed air preparation</li> <li>– Carrying out of component-specific inspections</li> </ul> </li> <li>• Service                             <ul style="list-style-type: none"> <li>– Lubrication/relubrication of guides</li> <li>– Tightening of connectors</li> <li>– Replacement of air filters</li> <li>– Replacement of silencers</li> <li>– Carrying out of component-specific preventive maintenance tasks</li> </ul> </li> <li>• Repair                             <ul style="list-style-type: none"> <li>– Troubleshooting</li> <li>– Solution finding</li> <li>– Error elimination</li> <li>– Elimination of leakages</li> <li>– Replacement or repair of components</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Inspection</li> <li>• Analysis of economic efficiency</li> <li>• Repair or replacement of faulty components or wearing parts</li> <li>• Leakage testing</li> <li>• Functional test</li> </ul> <p>Please send the faulty component and a detailed error description to your Festo national company. Detailed spare parts lists can be found on the Festo website.</p>	
<p><b>Description</b></p>	<ul style="list-style-type: none"> <li>• Preventive and corrective maintenance</li> <li>• Directly on your system</li> <li>• For high machine availability and rapid assistance should the worst happen</li> </ul>	<ul style="list-style-type: none"> <li>• Send high-quality components and assemblies to Festo for repair</li> <li>• Extended service life</li> <li>• Reducing costs</li> </ul>	
<p><b>Online:</b></p>	<p><a href="#">Services</a></p>	<p><a href="#">Services</a></p>	

## Energy Saving Services

				
<b>Type</b>	Compressed air generation energy analysis	Compressed air consumption analysis	Compressed air quality analysis	Leakage detection
<b>Services</b>	<ul style="list-style-type: none"> <li>• Measurement of compressor operating times as well as load/idling times</li> <li>• Power consumption measurement</li> <li>• Flow measurement/consumption measurement</li> <li>• Pressure measurement (level and band width)</li> <li>• Estimate of leakage volume</li> <li>• Comparison of energy consumption and compressed air volume supplied</li> </ul>	<ul style="list-style-type: none"> <li>• Installation and removal of the measuring equipment with standard components (fittings, tubing, etc.)</li> <li>• Measurement of flow rate, consumption and pressure with machine running and when idle</li> <li>• Determination and analysis of different characteristics                             <ul style="list-style-type: none"> <li>– Consumption per machine cycle</li> <li>– Average consumption per minute</li> <li>– Average pressure</li> <li>– Max./min. pressure</li> <li>– Max./min. rate of air flow</li> </ul> </li> <li>• Documentation of measurement results including graphical representation of measurement results, optionally available as PDF file or colour printout</li> <li>• 3 hours on-site service (additional time on request)</li> </ul>	<ul style="list-style-type: none"> <li>• Inspection of decentralised air preparation at point of usage</li> <li>• Measurement of the residual oil content up to class 2 (ISO 8573-1:2010)</li> <li>• Measurement of the pressure dew point up to class 2 (ISO 8573-1:2010)</li> <li>• Analysis of measurement results and recommendation of improvement measures (if applicable)</li> <li>• Documentation of all measurement results</li> <li>• 3 hours on-site service (max. 3 measurements; additional time on request)</li> </ul>	<ul style="list-style-type: none"> <li>• Detection of compressed air leakages using highly sensitive ultrasonic detectors during operation</li> <li>• Checking of the complete compressed air system from the compressor to the pneumatic application</li> <li>• Classification of the leakages according to size and cost</li> <li>• Documentation of faulty components as well as of the type and cause of fault</li> <li>• Leakage report                             <ul style="list-style-type: none"> <li>– Recommended measures</li> <li>– Spare parts required</li> <li>– Estimation of repair time</li> <li>– Prioritisation of measures</li> <li>– Assessment as to whether repair can be carried out while machine is in operation</li> </ul> </li> <li>• Information on optimisation options</li> <li>• Documentation of measures carried out</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>• Energy Saving Services – the service package for energy efficiency</li> <li>• Identification and optimum utilisation of potential savings for compressed air</li> <li>• Save up to 60% on compressed air costs</li> <li>• Energy saving begins with the compressor</li> </ul>	<ul style="list-style-type: none"> <li>• Determination of exact compressed air consumption</li> <li>• Optimal configuration of compressed air supply</li> <li>• No pressure drop due to undersupply</li> <li>• No unnecessary energy costs due to oversupply</li> </ul>	<ul style="list-style-type: none"> <li>• Optimisation of compressed air quality</li> <li>• Increased service life of components</li> <li>• Reduction of maintenance costs</li> </ul>	<ul style="list-style-type: none"> <li>• Detection and repair of leakages in production plants</li> <li>• Immediate energy and operating cost savings</li> </ul>
<b>Online:</b>	<a href="#">Services</a>	<a href="#">Services</a>	<a href="#">Services</a>	<a href="#">Services</a>

The Festo subsidiary Didactic provides up-to-date expertise in the form of comprehensive and efficient qualification and consultancy services for industry and vocational training.

### Training and consulting:

Festo offers a wide range of training services covering the three skills areas of technology, organisation and people and the three factors in productivity: quality, time and cost.

There are many methods and tools to achieve excellence in production. But which are the right ones?

You benefit from our project experience in many industry sectors and countries in the form of customised solutions with a focus on long-term success.



### The benefits of machine maintenance management include:

- Operating times increased by 40%
- Unexpected machine downtimes reduced by 95%
- Productivity increased by up to 50%
- Maintenance costs reduced by up to 30%

### The benefits of lean manufacturing include:

- On-time deliveries increased by 50%
- Inventory reduced by 30%
- Processing time reduced by up to 80%
- Employee productivity increased by 30%
- Non-quality costs reduced by 40%

### Training

We offer training courses and further education programmes for specialists and managers from industry. More than 3,000 events are attended by over 42,000 participants annually. Modular and high-quality course topics in 39 languages cover the subjects of people, technology and organisation.

### Consulting

The aim is always to identify and optimise value-added processes in order to make flows more efficient and prevent waste.

To achieve this, we use renowned methods and tools and we define the targets by which we are measured

Projects in the areas of:

- Production and logistics
- Management and teamwork

### Selection of current training courses:

#### Water management training courses

A new set of training courses delivers a compact introduction to the fundamental processes of water management. By participating in practical exercises, students gain technical knowledge and skills that can be applied immediately in day-to-day work and they become aware of how individual processes and actions in one section can influence the overall system. Since all components of the training equipment largely correspond to their “real” counterparts in function and design, the exercises become an authentic and thrilling experience.

- Water purification processes in modern water works
- Safe and efficient water transport and distribution
- Key processes of wastewater transport
- Fundamentals of modern wastewater treatment processes
- Monitoring, controlling and optimising operations in water and wastewater treatment plants
- Energy optimisation in water and wastewater treatment plants

#### Automated systems: Technology & Control

Festo Didactic has carefully developed a wide range of training courses to enable you achieve a high level of performance from your control solutions as well as save time with respect to their commissioning and integration. All of these courses are based on practical exercises using our latest products. A vast range of industrial applications are covered in these training sessions. To reduce potential downtimes, extensive troubleshooting exercises play an essential role in our training workshops.

Here is a summary of the new courses:

- PLC Programming
- Troubleshooting in control systems with PLC
- Valve terminals
- Saving energy in pneumatic systems
- Machinery safety

#### Handling Systems Training

Robotics has been rapidly evolving over the years, thereby increasing quality in production and the safety of workers.

Robotic systems are taking over certain tasks relating to productivity, quality, risks and ergonomics. The role of robotic systems is becoming ever more important and relevant on the shop floor. Therefore, we now offer a complete set of training modules that reveal the practical and technical knowledge of robotics and motion control.

- Robotics – Basics
- Motion control solution CMCA
- Maintenance of Tripod EXPT

Dates, locations and prices can be found on the Internet: → [www.festo-tac.com](http://www.festo-tac.com)

## What must be taken into account when using Festo products?

The limit values specified in the technical data and any specific safety instructions must be adhered to by the user in order to ensure correct functioning.

When using pneumatic components, ensure that they are operated using correctly prepared compressed air without aggressive media as well as compliance with environmental specifications (e.g. climate).

When Festo products are used in safety-oriented applications, all national and local laws and regulations, for example the Machinery Directive, together with the relevant references to standards, trade association rules and the applicable international regulations must be observed and complied with.

Unauthorised conversions or modifications to products and systems from Festo involve a safety risk and are thus not permitted. Festo does not accept any liability for resulting damages.

You should contact Festo's advisors if one of the following applies to your application:

- The ambient conditions and conditions of use or the operating medium differ from the specified technical data.
- The product is to perform a safety function.
- A risk or safety analysis is required.
- You are unsure about the product's suitability for use in the planned application.
- You are unsure about the product's suitability for use in safety-oriented applications.

All technical data are correct at the time of going to print.

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All technical data are subject to change according to technical updates.

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