

Air Management in Food Processing and Packaging





Safe, clean, efficient

The processing and packaging of food products has to comply with highly specific requirements. Automation processes not only have to be safe and efficient – cleanliness and hygiene are also top priorities. Thanks to the clean and safe medium of compressed air, pneumatic processes are ideal for these requirements.

That special plus – our experience in the food and packaging industry

In the food industry, there is no room for semi-professional product handling. When it comes to automation, relying on proven expertise is a must! Rely on solutions that are not only fully compliant and absolutely hygienic, but also economically efficient. Just what you get from Rexroth.

Application-specific automation solutions with pneumatics

The diverse tasks and working conditions in the food and packaging industry require solutions that are just as varied. Based on a comprehensive product program and custom configurations, our service spectrum focuses on providing users with tailor-made solutions for their specific application. With unparalleled product quality and expert service.

- ▶ Best in class pneumatic solutions
- ▶ Advanced engineering tools
- ▶ Industry-oriented product portfolio

Together with our customers, we have developed a broad product portfolio that is precisely tailored to meet the needs of the industry. The result? Products, systems, and complete solutions that are best in class in all respects and exactly fit your purpose. Talk to one of our industry experts available throughout the world.

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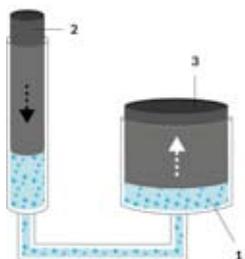
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Topic: drive technology in automation

For automated motion, three basic drive technologies are used, each of which have different strengths and weaknesses, and can also complement each other in a single application. Key decision-making factors for selecting the appropriate drive principle are varied and determined by the applications, although hydraulics are often used when major forces are involved. In contrast, electric and pneumatic drives operate in the same field

of automation and should be implemented according to their respective benefits. Because Rexroth covers the entire drive and control spectrum, users can receive neutral technology advice and application solutions that present an optimum mix of multiple technologies.

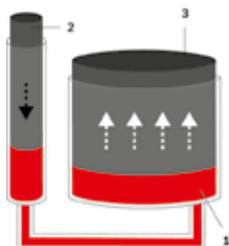


Air is converted to compressed air by compressors and the stored energy is converted to mechanical energy or "work" by cylinders, motors or other consumers. (1) Ambient air is pressurized in a (2) compressor and moves a (3) working piston.

Pneumatic drives

"Pneumatics have nimble fingers." They are used primarily when small masses need to be set in motion at high speeds across short distances. In addition, flow properties can also be utilized for specific pneumatic applications.

- ▶ The speed and force of the actuators can be controlled simply and continuously over a wide range
- ▶ Producing compressed air can require inordinate effort if the application has been incorrectly configured



Fluid is pressurized to move a piston in a cylinder. The flow is provided by a pump. A (1) fluid is pressurized by a (2) pressure piston and lifts a (3) working piston.

Hydraulic drives

"Hydraulics have strong arms." Hydraulics are deployed where great forces are required. There are three subcategories for special applications:

Hydrostatics:

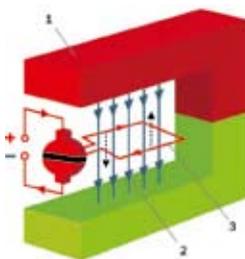
- ▶ Extremely efficient, fully mature machine engineering
- ▶ The oil used as the pressure medium is elastic, making it difficult to maintain positions once attained

Secondary control:

- ▶ Highly efficient technology
- ▶ Expensive to build; only for special applications

Valve-controlled:

- ▶ High accuracy, precise control, very low efficiency



Electric energy is transformed into energy for mechanical motion. Two magnetic fields work together to generate a torque. A stationary (1) magnet (stator) generates (2) magnetic field. The force of this field sets a current carrying (3) coil (rotor) into motion.

Electrical drives

"Electrics have precise hands." They offer high speed and great accuracy. There are different types of electric motors:

DC motor:

- ▶ Very good adjustment of speed and force
- ▶ Required carbon brushes are wearing parts

Synchronous motor:

- ▶ Excellent energy efficiency and high overall efficiency
- ▶ Requires complex electronic control; very expensive permanent magnets

Asynchronous motor:

- ▶ Simple and inexpensive to manufacture
- ▶ Low efficiency due to current leakage

Advantages of pneumatics in automation technology

Professionally applied compressed air results in highly efficient solutions

The advantages of intelligently implemented pneumatic solutions add up in many areas, both technically and economically. The components have a simple, robust design. This makes them reliable, operationally safe and low-maintenance, thus guaranteeing a long service life. Compressed air does not pose a risk in relation to fire or explosion hazards and is absolutely unaffected by high temperatures and temperature fluctuations. Moreover, optimum dimensioning and energy efficient configuration of components reduces compressed air consumption to a minimum.

- ▶ Simple, compact, reliable, low-maintenance, and durable technology
- ▶ Clean, harmless, readily available and safe medium



Pneumatics can be optimally combined with other drive technologies

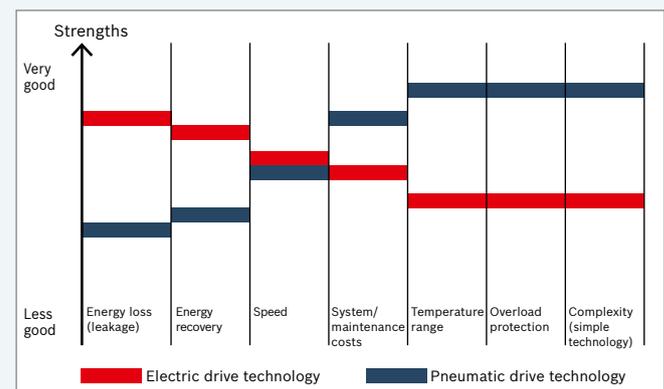
For linear and rotating movements, as well as gripping functions, Rexroth can provide the optimum combination of matching products – electric drive technology and pneumatics can be directly combined with no problems. The individual advantages of the specific drive technology come together to form an optimum overall solution, both in terms of function and economics.



The ideal technology for applications in the food and packaging industry

Technological simplicity and the clean and safe medium of compressed air make pneumatics ideal for applications in hygienically sensitive areas of the food industry. In addition, pneumatics can provide wide-ranging benefits in terms of system and maintenance costs, temperature ranges, and an enormous overload capacity.

Profiling strengths: Electric and pneumatic drives (relevant parameters)



- ▶ **Unlimited resource**
- ▶ **Low procurement costs**
- ▶ **High reliability, overload-proof**
- ▶ **Low maintenance effort**
- ▶ **Small size, increasing miniaturization**
- ▶ **High flexibility**
- ▶ **Sometimes only possible drive type, e.g. in EX-protection areas**

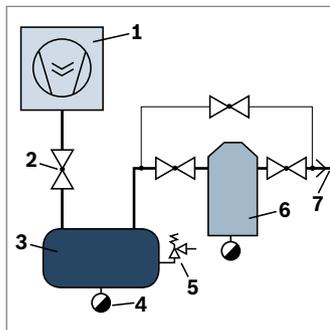
Get efficient right from the start

Structure of pneumatic systems

Pneumatic drive systems mainly comprise the subsystems of compressed air generation, distribution and the actual processing of compressed air, including the preparation, control and actuators. Compressed air generation and distribution supply the networked individual pneumatic applications with the required basic pressure, which can be tailored to the specific application.

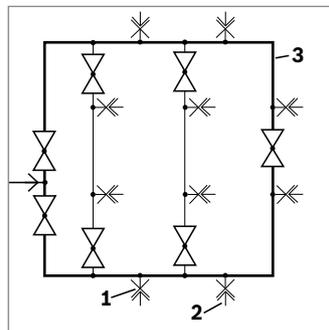
- ▶ Compressed air generation
- ▶ Compressed air distribution
- ▶ Compressed air processing

Well functioning, efficient automation solutions require a properly configured pneumatic application, including compressed air preparation, valves and valve terminal systems, cylinders and guide units, as well as components from gripper and vacuum technology.



Compressed air generation

1. Compressor
2. Shut-off valve
3. Compressed air reservoir
4. Condensate drain
5. Safety valve
6. Compressed air dryer
7. Mains pipe



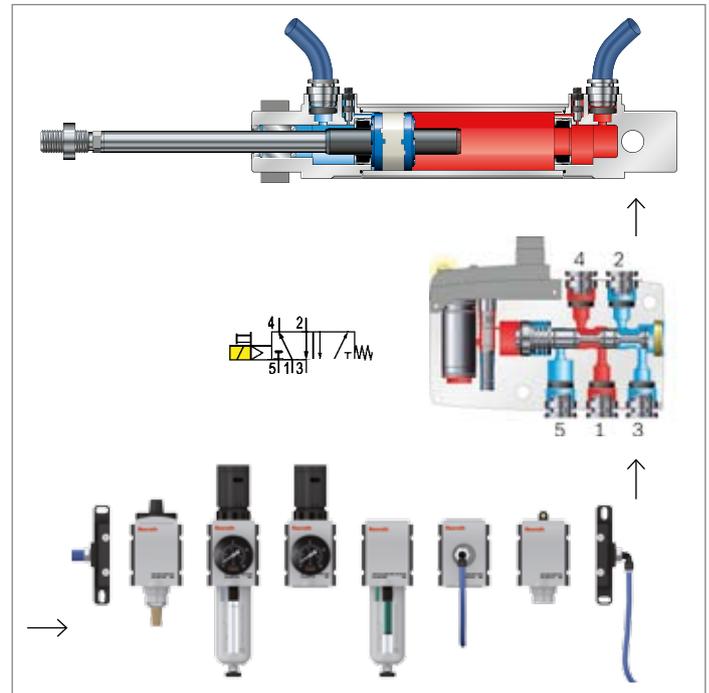
Compressed air distribution

1. Compressed air connection
2. Connection tube
3. Compressed air ring main

Pneumatic applications for food & packaging

The application range is as diverse as the spectrum of food products. Each automation task must be individually designed according to the application area.

- ▶ Simple handling tasks for filling, transportation and packaging
- ▶ Safe, rapid and reliable control of process valves and filling cylinders during filling processes



Configuring pneumatic applications

- ▶ Compressed air preparation
- ▶ Valves and valve terminal systems
- ▶ Cylinders and accessories
- ▶ Gripper and vacuum components

Optimized and efficient pneumatic solutions through correct dimensioning

Fundamental selection and layout criteria

To ensure that a pneumatic solution not only functions, but also “works” reliably and economically in the long term, thorough planning is vital. In addition, basic knowledge of component operation and characteristics and their interplay are required. Don’t hesitate to ask – we are well equipped with answers!

Selection criteria for cylinders

- ▶ Force, time, pressure, and air consumption
- ▶ Standard, cushioning, sensors
- ▶ Application area, temperature

Selection criteria for valves

- ▶ Pressure range, valve functions, connection types
- ▶ Single valve/valve terminal system, electrical control
- ▶ Air consumption in the application
- ▶ Application area, temperature



Needs-based dimensioning – the key to energy efficiency

Correct component dimensioning is decisive in avoiding excessive air consumption due to oversized components from the very start. Rexroth provides the right compact components, from compressed air preparation to valve technology and actuators, as well as free-of-charge professional engineering programs.

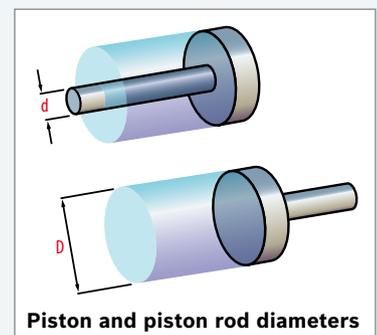
Selecting the correct cylinder based on:

- ▶ Required force
- ▶ Available pressure

Calculating extending piston force: ▶ Useful surface of piston D (mm²) x working pressure P (bar)/10
Calculating retracting piston force: ▶ Piston surface D (mm²) – d (mm²) x working pressure P (bar)/10

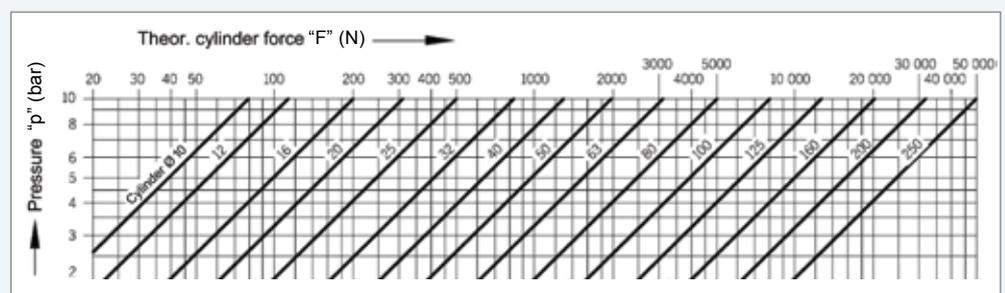
In practice: 25-50% more force required for uniform, controllable movement:

- ▶ Friction
- ▶ Variable counterforce from the cylinder’s exhaust chamber, depending on the cylinder speed
 - ▶ High speeds: + 25%
 - ▶ Low speeds: + 50%
 - ▶ Slow speeds: + 100%



Estimating cylinder size
using a force/pressure diagram including frictional loss

Theoretical cylinder forces
including buckling safety for cylinders loaded in the axial direction

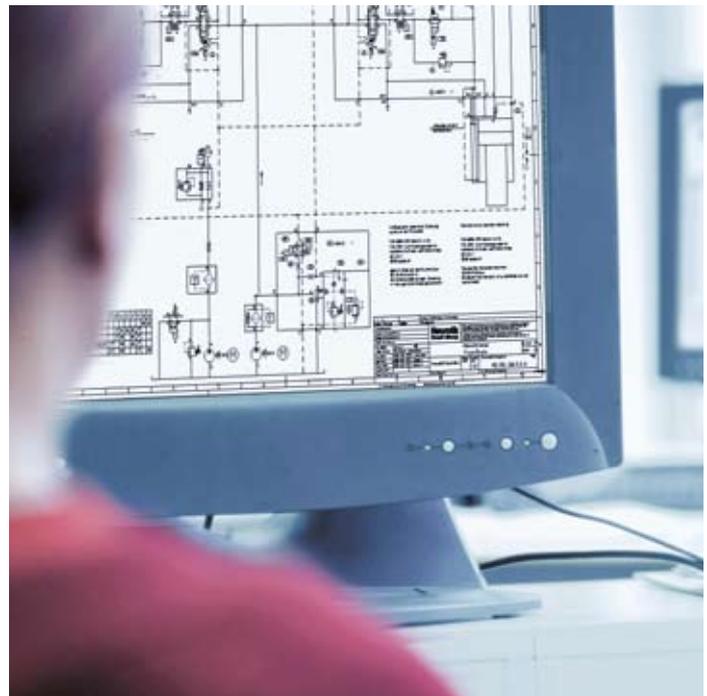


Technologically advanced, yet easy to use, free of charge and no CAD license required – an exclusive engineering package from Rexroth

Online calculation tools, configurators and the D&C Scheme Editor

After determining the basic technology, the true optimization of the pneumatic solution begins with the selection and configuration of components. Our tools and calculation programs not only calculate the basic component configuration, but also provide important notes on alternative solutions and relevant accessory parts. With logical, intuitive navigation, all bases are covered.

- ▶ Determining components and systems
- ▶ Evaluating functioning, cost-effectiveness and energy efficiency
- ▶ Configuration with circuit diagram software
- ▶ Selection and configuration of individual components
- ▶ Calculating and simulating air consumption



For example: Online cylinder calculation tool, including energy savings tips!

Piston calculation program 30/11/11 10:48
Program Information Version: 1.0.0

Workshop:
Werkstatt (Piston) [g]
Application:
Load movement
Piston movement
Substructure
Piston Rod
Pressure 600
P 10 1.0 bar
Tube length L
6 1.0 mm
Stroke 100 mm
New for new series [g]
Cylinder:
Cylinder
Two chamber
Pre conditioned element
No oil coating

The program result may be seen as a recommendation for choice of components. Bosch Rexroth AG may not be held li...

Dimensioning data	Load %	9%	Output data
Max. allowable mass [kg]	<input type="text" value="0"/>		Cylinder diameter [mm]
Acceleration	<input type="text" value="0"/>		Start time [s]
Top speed [m/s]	<input type="text" value="0"/>		Velocity [m/s]
Top speed [m/s]	<input type="text" value="0"/>		Stroke time [s]
Coasting	<input type="text" value="0"/>		Max. cylinder force [N]
			View Co [N/mm²]
			Min. inner diameter [mm]

Piston calculation program 30/11/11 11:39 AM
Program Information Version: 1.0.0

Workshop:
Werkstatt (Piston) [g]
Application:
Load movement
Piston movement

Max. Load [kg] 10
Horizontal [x]
Piston [x]
60
1.0
1.0
1.0
1.0
1.0
1.0
1.0

BD Profile (Ea 33-12) P04
Profile [x]
Area [x]
No [x]
Rear side [x]

Energy saving potential - Mozilla Firefox
http://www.boschrexroth.com/computation/piston_rod_cylinders/ene...
Energy saving potential (84%)
The cylinder size was determined by the load movement.
By selecting horizontal with guide the result will be diameter[mm]: 32
Close

The program result may be seen as a recommendation for choice of components. Bosch Rexroth AG may not be held li...

Dimensioning data	Load %	7%	Output data
Max. allowable mass [kg]	<input type="text" value="0"/>		Cylinder diameter [mm]
Acceleration	<input type="text" value="0"/>		Start time [s]
(Acceptable or not)	<input type="text" value="0"/>		Velocity [m/s]
Total time [m/s]	<input type="text" value="0"/>		Stroke time [s]
Coasting	<input type="text" value="0"/>		Max. cylinder force [N]
Backing pressure	<input type="text" value="0"/>		View Co [N/mm²]
			Min. inner diameter [mm]

Energy [x]
Catalog [x]
Configure [x]
Energy [x]
PDF [x]

Program setup

- 1 | Model explorer
- 2 | Model view
- 3 | Library
- 4 | Component preview
- 5 | Parts list
- 6 | Properties

D&C Scheme Editor: Parameterize components, define cycles and determine air consumption

Action	Duration (s)	Predecessor	Air Consumption
Extend	13	000	2.27
Retract	5	005	0.00
Extend	1	010	1.24
Retract	2	011	46.30
Extend	13	012	0.00
Retract	1	014	0.00
Retract	2	014	43.61

Air Consumption		Energy Demand Air Production	
per cycle	132.9 l	per cycle	9.001 kWh
per hour	11 m³	per hour	0.11 kWh
per month	443.96 m³	per month	4.4 kWh
per day	88.01 m³	per day	0.88 kWh
per year	2.264 m³	per year	22.64 kWh

D&C Scheme Editor – configuration complete with ready-to-order parts list

The D&C Scheme Editor offers intuitive operation linked with extended online tools

With the circuit diagram software D&C Scheme Editor, you can create ready-to-use configurations including air consumption analyses and documentation that factor in all aspects for an energy-efficient design.

- ▶ Easy-to-use circuit diagram software for designs in compliance with standards
- ▶ Pneumatic circuit diagrams
- ▶ Free-of-charge download available online
- ▶ Operates without a CAD license
- ▶ Consistency of tools (same user interface), no need to jump between applications

The direct link between the program and relevant online tools on our Internet platform is especially important. www.boschrexroth.com/pneumatics-catalog

Rexroth
Bosch Group

From design to delivery

Rexroth's homepage supports you in all different aspects of your business process. Our design tools consists of product configurator programs, a CAD based product configuration, product catalogue and so on along for online pricing, ordering, availability and order status.

Before ordering

- Technical information
- Parameter search
- Product configuration system
- Product configuration
- CAD files

Ordering

- Price information
- Check and update info
- Place order

Delivery

- Order status

Support

- Maintenance instruction

Online tools at your service:

- ▶ All products and technical details in the online catalog
- ▶ Calculation and conversion tools
- ▶ Product configurators for a complete unit, including accessories and comprehensive technical documentation
- ▶ D&C Scheme Editor with air consumption calculator
- ▶ eShop with price and supplier information in the shopping basket

Pneumatic solutions for food processing and packaging

You know the bottom line for the production and successful marketing of healthy food products: quality and attractive prices. And we know-how to create automation solutions that will increase the efficiency of your processes – with no changes in product quality, just lower total costs. Talk to us today!

Product requirements for specific application areas

When selecting the right components, the key factors include where and for what purpose the devices are used. The relevant standards and specifications of individual organizations and legislative bodies require strict compliance. As relevant standards, DIN EN 1672-2:2005 classifies three main zones: food, splash, and non-food zones; EHEDG and ISO 14159 define two types of surfaces: product contact and non-product contact surfaces.

Food zone

This area includes all surfaces that come into contact or could come into contact with food and where there is a risk of food splash returning into the food process.

Splash zone

This area includes surfaces where the food may splash or flow along them, but without the risk of food returning into the food process after coming into contact with these surfaces.

Non-food zone

All areas that are neither food zones nor splash zones.

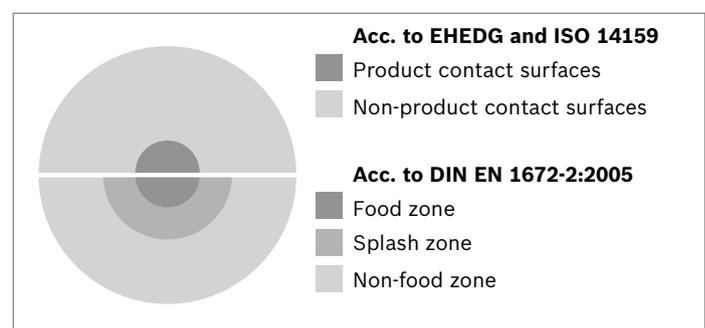


Product contact surfaces

This basically includes all equipment surfaces that intentionally or unintentionally come or could come into contact with the product, or from which product or condensate may drain, drop or be drawn back into the main product or product container.

Non-product contact surfaces

All other exposed surfaces.



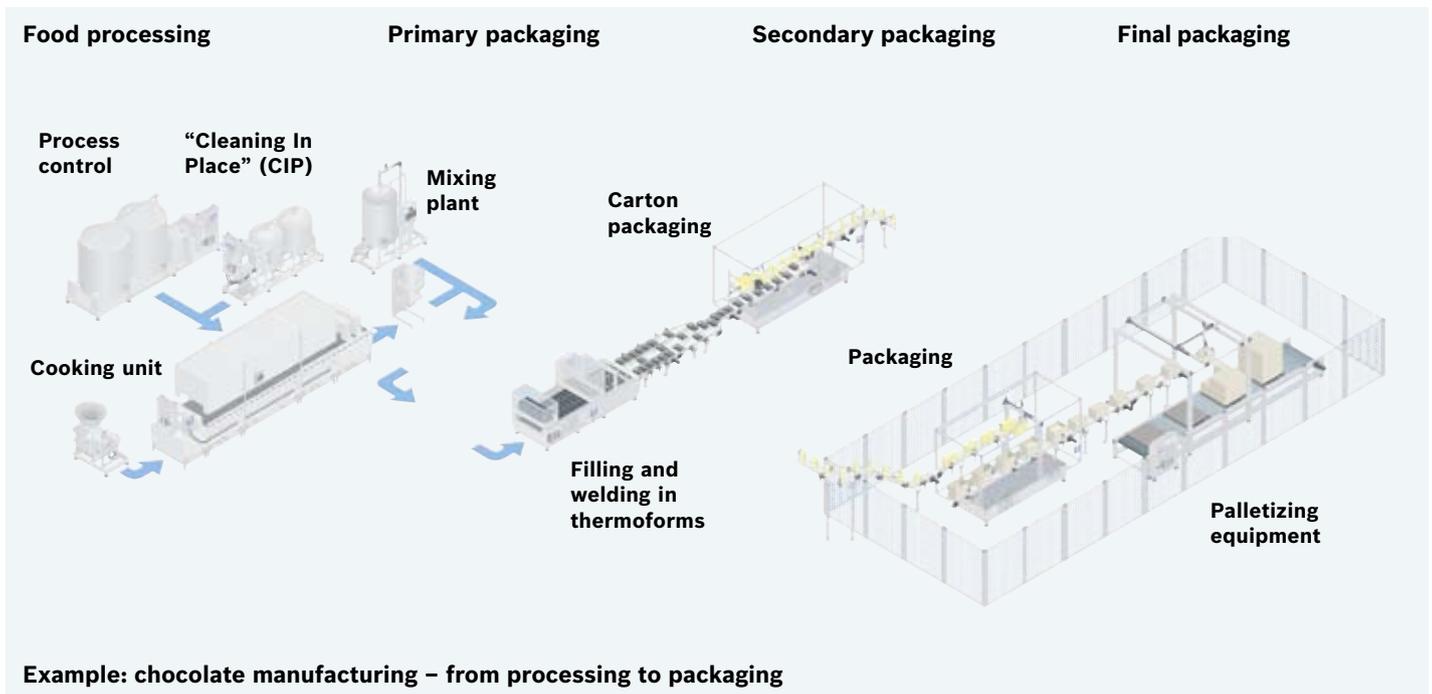
The Rexroth concept: structured, competent, proven

A product portfolio that is perfectly tailored to specific application areas

Few other industries specify such a large number of directives, guidelines or standards for handling as the food and packaging industry. Food is a sensitive good; its handling also means high requirements on automation. We provide a well-rounded industry concept individually geared toward the application. The information on the following pages shows what pneumatics can accomplish in your industry and

what the key criteria are for sustainable solutions in line with diverse specifications.

- ▶ Food processing
- ▶ Primary packaging
- ▶ Secondary packaging
- ▶ Final packaging



Food processing

Due to direct contact with food products, only components that meet the highest standards are used in this area.

Primary packaging

Primary packaging usually involves direct or indirect contact with food products. Hygienically designed components must be used.

Secondary packaging

For secondary packaging that does not involve direct or indirect food contact, components without extra hygienic features can be used.

Final packaging

During final packaging, contact with food can safely be excluded. Standard pneumatic components are suitable for use.

Food safety measures

Expertise from Rexroth – safety in knowledge

To ensure food safety for consumers, a large number of binding legislative directives and standards have been developed. With their numerous requirements, it is often difficult to determine which aspects of individual standards are relevant for specific applications. Which measures must be taken? For these assessments, you can rely completely on our experts, who address these topics on a daily basis – safety in knowledge.

In this context, the relevant directives and standards target two main areas:

- ▶ Machine design
- ▶ Production process

A system's suitability for food products can only be ensured when all requirements related to both aspects are fulfilled.

Legislative bodies



U.S. Food and Drug Administration (FDA)



United States Department of Agriculture (USDA)



European Union directives:
EC 1935/2004, 2002/72/EC, 2006/42/EC,
EC 852/2004, EC 2023/2006

Organizations that issue implementation guidelines for legislation:



European Hygienic Engineering and Design Group (EHEDG)



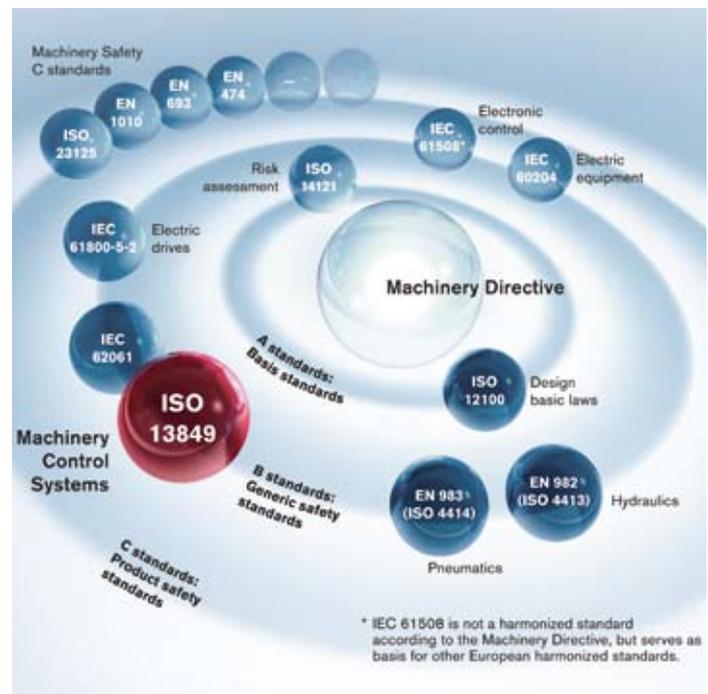
National Sanitation Foundation International (NSF International)



3-A Sanitary Standards, Inc. (3-A SSI)



Working together to harmonize guidelines and standards



Rexroth components meet the highest standards

As part of our industry-oriented product concept, components for the food and packaging industry are consistently designed and equipped according to standards and directives. They meet all requirements applicable to the respective purpose and area at the highest level.

A professional hazard analysis provides the best assurance

Food zone and product contact surfaces

Products and components are subject to the highest requirements when they come into direct contact with food or in areas with product contact surfaces. This applies to both hygienic design, including lubricants, and the properties of the materials used.

Materials used

The main materials used in food processing equipment must exhibit a high mechanical strength, be easy to fabricate and to repair, and possess both desirable hygienic and thermal properties. The most important requirements are:

- ▶ Materials must be corrosion-resistant
- ▶ Materials must be non-absorbent
- ▶ Materials must be non-toxic

Hygienic design

An initial requirement for hygienic design is that all machine parts that might come into contact with food products have to be cleanable and easy to disinfect.

- ▶ Avoid: bolts, screws, small gaps
- ▶ Requirements: self-draining, no dead spaces, food-grade lubricants

The specific design should permit good and complete cleaning, with a surface finish that will prevent particles from remaining in small cavities. Hygienically designed components from Rexroth fulfill all these requirements on a best-practice level. This applies to both their hygienic design and the materials used. In addition, Rexroth supports customers in the implementation of the necessary hazard analysis.



Hazard analysis and HACCP plan

The HACCP system is a science-based process control system aimed at greatly reducing serious food hazards to consumers through effective prevention.

- ▶ Biological hazards
- ▶ Chemical hazards
- ▶ Physical hazards

Critical Control Point (CCP)

A step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

Hazard Analysis and Critical Control Points (HACCP)

As an example, an HACCP plan can consist of seven parts. Other variants are possible.

1. Conduct a hazard analysis
2. Determine critical control points (CCPs)
3. Establish critical limits
4. Establish monitoring procedures
5. Establish corrective actions
6. Establish verification procedures
7. Establish record-keeping and documentation procedures

Hygienic design and temperature management

Hygienic design is a highly complex task

Machinery and equipment possess a good hygienic design if they were planned and realized in such a way so they stay free of food residue and micro-organisms and avoid contamination of the produced foods. This means:

- ▶ Avoidance of:
 - Ridges, crevices, and sharp edges, contamination collecting parts, non-cleanable areas
- ▶ No food contact with lubricants
- ▶ Easy to clean and disinfect
- ▶ Only food-safe lubricants

As a welcome side effect: the sound implementation of hygienic requirements and optimum adaptation to specific working environments may increase the life expectancy of equipment, reduce maintenance and consequently lead to lower production costs.



- ▶ Use of non-toxic, non-absorbent materials that are resistant to cleaning and disinfection agents
- ▶ Compression of elastomers must be controlled
- ▶ Extremely smooth, self-draining surface designs: slope $\geq 3^\circ$, roughness (Ra) $\leq 0.8 \mu\text{m}$

Temperature management for extreme applications

In addition to sound hygienic properties, pneumatic components must be able to withstand extreme temperatures during food processing and packaging.

- ▶ Suitability of components for trouble-free continuous operation with strong temperature fluctuations
- ▶ Component design for extreme temperature ranges from -45°C to $+250^\circ\text{C}$

In these temperature ranges, safe continuous operation must be ensured not only by the materials and parts used, but also the seals, pneumatic connection elements and lubricants required throughout the entire system.



ICS and CPC cylinder series

The round cylinders fulfill the highest requirements for hygienic design. They are available in a variety of dimensions and versions.



Perfect cleaning – a fundamental requirement for optimum hygiene

Corrosion resistance, hygienic suitability and electrical protection class

To ensure sustainable food safety, the equipment and its surrounding parts have to be cleaned and disinfected at regular intervals. Therefore, components should be selected based on their ability to withstand the cleaning process for a specific application. The components must be judged by their corrosion resistance, their hygienic suitability and their electrical protection (IP) code.



A good hygienic design also makes it possible to clean and disinfect faster, at lower temperatures, and with less aggressive detergents, thus saving time and costs. In addition, it is important to determine the necessary type of cleaning and cleaning intervals, which can normally be done after performing a hazard analysis.

Hygiene standards according to zones

Zoning is implemented with the aim of separating different activities with different hygiene levels from each other. The goal of zoning is an easier definition of specific hygiene requirements for each sub-area.

- ▶ High, medium, and low hygiene standards

High hygiene standards apply for a high risk area where highly sensitive foodstuffs are processed, treated, handled or stored.

Corrosion resistance classes

Class	Materials
1	<ul style="list-style-type: none"> ▶ Acid-proof, stainless steel ▶ Plastics, e.g. PVC, polyethylene, PTFE, PEEK, silicone rubber
2	<ul style="list-style-type: none"> ▶ Hard chrome-plated steel ▶ Steels, e.g. AISI 420, 430F ▶ Nickel-plated steel and brass ▶ Chemically nickel-plated and anodized aluminum ▶ Plastics, e.g. polyamide 6.6, POM, rubber, PU, nitrile rubber, NBR, Buna N
3	<ul style="list-style-type: none"> ▶ Galvanized steel ▶ Bronze, brass, zinc ▶ Plastics such as polycarbonate ▶ Untreated aluminum

1 = excellent
2 = good
3 = normal

Hygiene classes

Class	Design
1	<ul style="list-style-type: none"> Hygienic design ▶ Smooth surfaces (no notches or pores) ▶ Rounded corners and edges ▶ No dead spaces ▶ Self-draining ▶ Use of NSF H1 certified lubricants
2	<ul style="list-style-type: none"> Clean design ▶ Some dead spaces present ▶ Self-draining ▶ Use of NSF H1 certified lubricants
3	<ul style="list-style-type: none"> Standard construction ▶ No complete avoidance of dead spaces ▶ Satisfactory ease of cleaning ▶ Use of NSF H2 certified lubricants

Protection classes

Class	Protection against contact, foreign bodies and water
1	Products that fulfill the requirements of IP65, IP67 and IP69K have the highest protection class: total protection against dust; protection against low-pressure water jets from all sides; protection against the effects of immersion in water depths of 1 m; protection against cleaning with high-pressure jets of water and steam jet cleaning
2	Products that fulfill the requirements of IP65 and IP67 have the second highest protection class: total protection against dust; protection against low-pressure water jets from all sides; protection against the effects of immersion in water depths of 1 m
3	Products that only fulfill the requirements of IP65 have the third highest protection class: total protection against dust; protection against low-pressure water jets from all sides

An optimum compressed air quality ensures the function and durability of pneumatic automation processes

Why compressed air quality matters

When used in the food & beverage industry, compressed air quality is a further important point that is inspected during an HACCP audit. Compressed air preparation as a standard machine element is a compulsory part of the Machinery Directive (EN ISO 13849). Good compressed air preparation provides a major advantage throughout the entire pneumatic application.

Consequences of poor compressed air quality:

- ▶ Corrosion of components, shorter service life
- ▶ Product malfunction, reduction in speed
- ▶ Rapid wear and tear on seals, contaminated silencers
- ▶ Higher energy costs due to leakages, higher maintenance costs

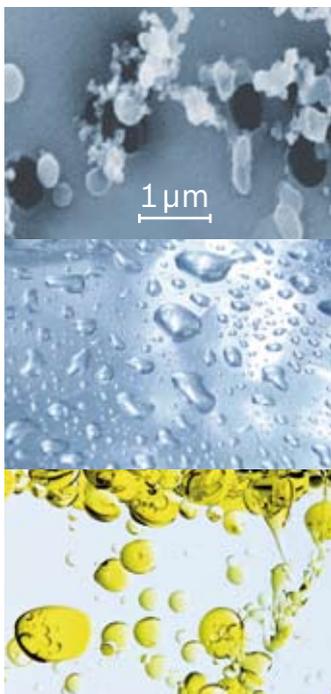


Example configuration of a compressed air preparation unit

Depending on where and for what purpose the compressed air is used, special filters may be added downstream of the standard 5 µm filter. In addition, a 0.3 µm pre-filter can be installed, followed by a 0.01 µm microfilter. This combination retains 99.99% of the solids, oil and water carried by the compressed air. To lower the pressure dew point (PDP) and thus the water content in the air, a diaphragm-type dryer can be used. And to remove any taste of oil and remaining vapors, an active carbon filter can be added to reduce the oil content to below 0.003 mg/m³. All of these components can be found in the AS or NL series from Rexroth.

Possible contaminants due to poor compressed air preparation

- ▶ Compressed air in its unprocessed form is by no means clean
- ▶ One cubic meter of compressed air contains up to 180 million dirt particles, 80 g of water, 0.03 mg of oil as well as lead, cadmium and mercury
- ▶ The contaminating elements may even react with each another and combine to form emulsions
- ▶ Poor air preparation can lead to contaminated products and, in the worst case, to injuries



Residual dust

Particles in compressed air lines can cause excessive wear through their abrasive action or block small passages in components.

Residual water

If too much residual moisture is present, this may combine with the lubricants in pneumatic components.

Residual oils

Residual oils can damage components and, in a worst case scenario, contaminate the product.

Because no lubrication is a “no go” – important criteria for lubricants

The right lubrication with approved lubricants

Lubricating agents are indispensable for the lubrication, heat transfer, power transmission, and corrosion protection of machinery, machine parts, equipment, and instruments. To ensure food safety, the combination, production and use of lubricants that come into contact with food products are specified in binding legislation.

Requirements for lubricants

Lubricants suitable for the food processing industry must:

- ▶ Comply with food regulations, be internationally approved
- ▶ Be physiologically inert, without taste or smell

Furthermore, the lubricants must meet the following technical requirements and, subject to the individual application, exhibit the following properties and qualities:

- ▶ Reduction of friction and wear, protection against corrosion
- ▶ Dissipation of heat, sealing effect
- ▶ Resistance to water, steam and chemicals
- ▶ Sugar dissolving properties
- ▶ Compatibility with rubber and sealing materials

Selecting lubricants

If a risk of lubricant entering the food process cannot be excluded, NSF H1 lubricants must be used. NSF H1 lubricants are not damaging to health, have a neutral taste and are internationally approved. Because we do not take any unnecessary risks in this area, we exclusively use NSF H1 certified lubricants for all food & packaging components.



Categorization of lubricants:

The NSF (National Sanitation Foundation) develops standards for public safety and health, and provides product certifications and required training.

NSF H1 code category:

Lubricants that unintentionally come into contact with food products; must comply with FDA Regulation 21 CFR 178.3570; may be used in food-processing industries in which occasional contact with foodstuffs occurs.

NSF H2 code category:

Lubricants that may not come into contact with food products; may be used in machines and accompanying equipment in which contact with foodstuffs is reliably excluded.

NSF H3 code category:

Edible oils

Optimal machine safety

Relevant safety standards and parameters

Implementing machine safety is a highly complex task governed by a wide variety of directives and standards. With the support of our specialists, we can help our customers with their risk assessments and definition of performance levels, enabling them to optimize product safety according to all relevant standards.

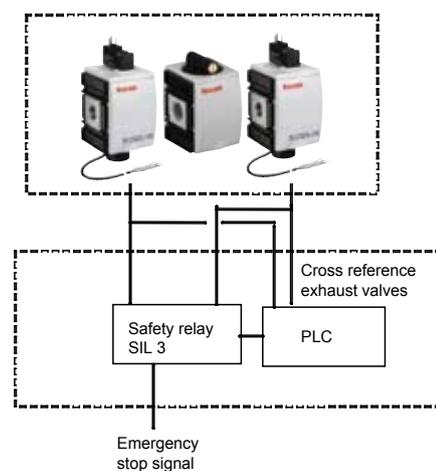
- ▶ PL (Performance Level), discrete level to specify the ability of safety-related parts in control systems to perform a safety function under foreseeable conditions
- ▶ B_{10d} , the expected number of cycles until 10% of the components fail dangerously
- ▶ PFH_d , the probability of a dangerous failure per operating hour (reference value for PL and SIL)
- ▶ $MTTF_d$, mean time to dangerous failure, the expected value of the mean time to dangerous failure
- ▶ SIL, the safety integrity level



Systematic instructions for implementing functional safety while complying with standards

Rexroth has developed guidelines that systematize the assessment, conception, and implementation of safety functions. Designers can use it to define the required performance level in line with standards in just ten steps, inspect all details for compliance with the safety principles, and then validate the achieved safety level.

Example: safe exhaust with the AS maintenance unit



- ▶ In compliance with DIN EN ISO 13849-1
- ▶ Complies with Safety Integrity Level (SIL) SIL 3 safety component (analog to cat 4 PLe)
- ▶ Safe exhaust module as stand-alone or as integral part of air supply unit
- ▶ Two exhaust valves (redundant) with position monitoring

Just 10 steps to the performance level

1. Perform a risk assessment in accordance with ISO 14121
2. Identify safety functions (SF)
3. Define the required performance level (PL_r)
4. Select the system structure (category)
5. Model the circuit type using a block diagram: SISTEMA software
6. Select reliable components (MTTF)
7. Assess monitoring: diagnostic coverage
8. Assess controller robustness (CCF)
9. Check further requirements
10. Verify/validate the achieved performance level (PL)

Electrical protection classes and ATEX

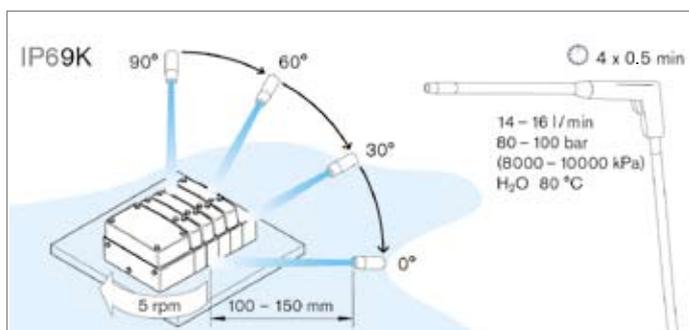
IP code: protection against solids, protection against liquids

A variety of rating systems are used to define the degree of protection provided by an enclosure against external influences. The standards DIN 40050 and IEC 60529 define the degree of protection according to the IP code in order to simplify the product selection for specific applications. Components from Rexroth feature high protection classes and are therefore ideal for use in the areas of food processing and packaging. As a general rule, higher protection classes enable a more decentralized use of components in food and wash-down applications.

IP6X = Totally protected against dust

The IP standards are classified by a two-digit code. IP6X refers to an enclosure that is dust-tight. The second digit refers to the ability to keep out water from high pressure/steam cleaning.

Designation	Meaning
IP65	Protected against low-pressure jets of water from all directions
IP66	Protected against strong jets of water
IP67	Protected against the effects of immersion in water at a depth of 1 m
IP68	Protected against the effects of continuous immersion in water at a depth exceeding 1 m
IP69K	Protected against high-pressure water and steam jet cleaning

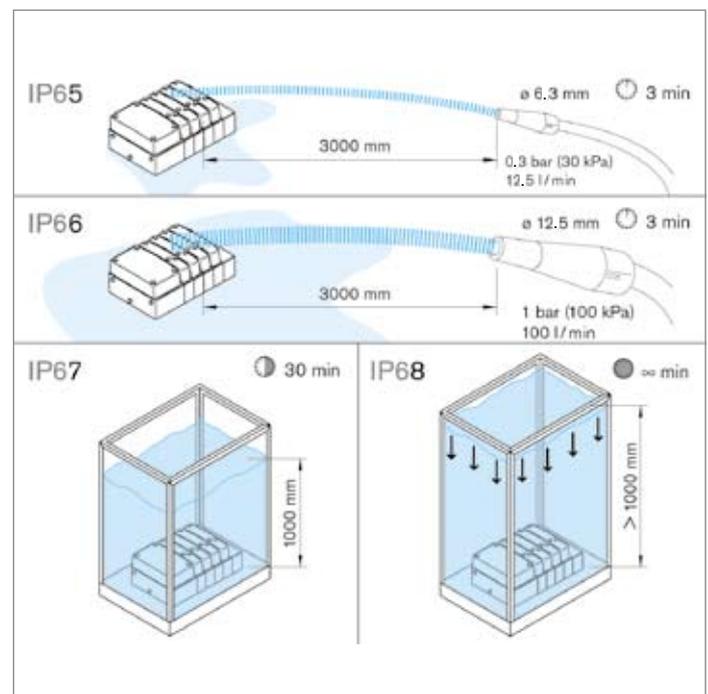


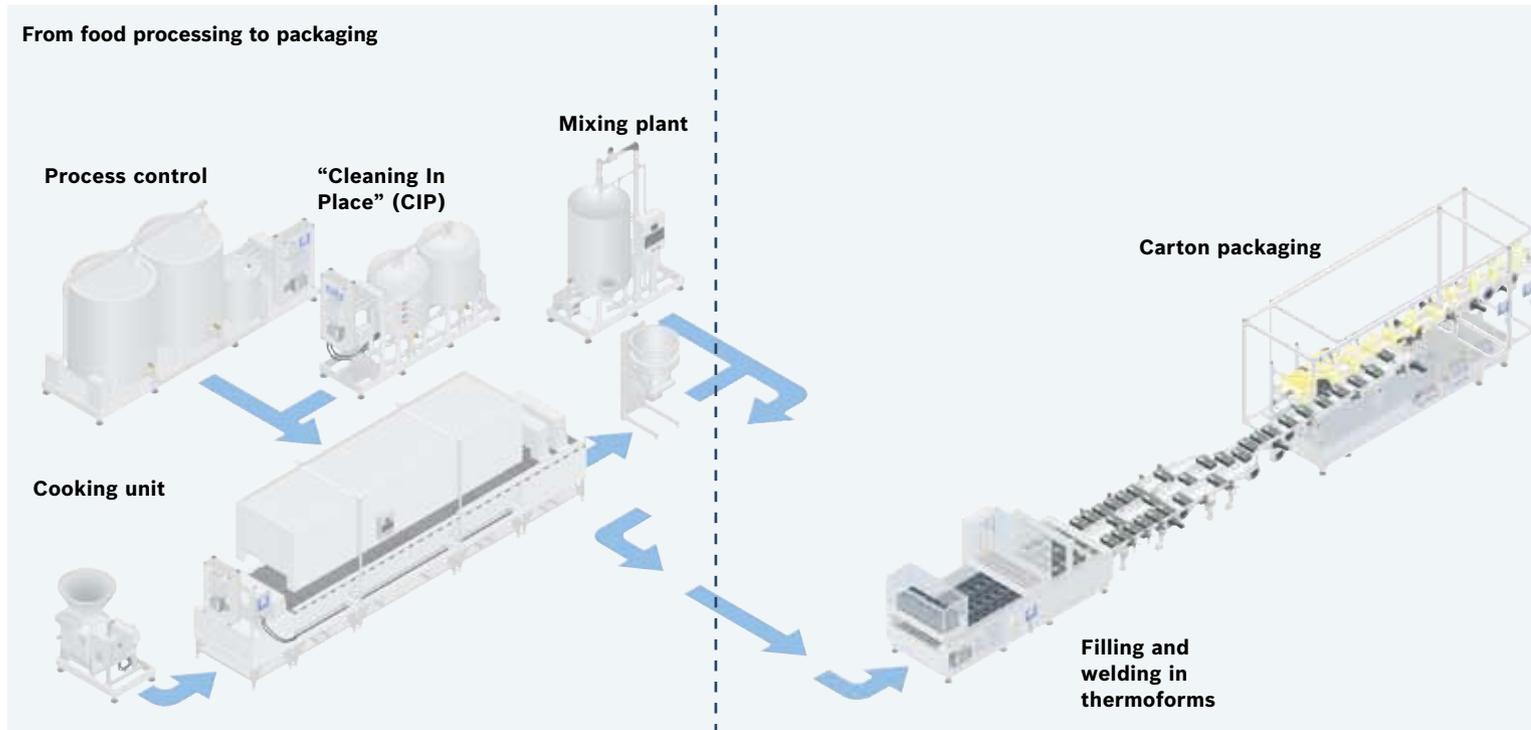
ATEX zones and pneumatic components

ATEX directives regulate the safety for equipment and protective systems that are used in explosive areas. Potentially explosive atmospheres can be found in mills, silos, and sugar factories, as well as in certain other environments. For this reason, the ATEX directives apply to both electrical and non-electrical equipment and devices, such as pneumatic drives.

- ▶ Division into zones according to the assessed danger potential
- ▶ Determination of temperature classes and explosion groups
- ▶ Determination of experienced temperatures

The system operator is responsible for defining hazardous zones; the operator sets the hazard zones, evaluates risks and documents appropriate protective measures. And Rexroth provides a helping hand!





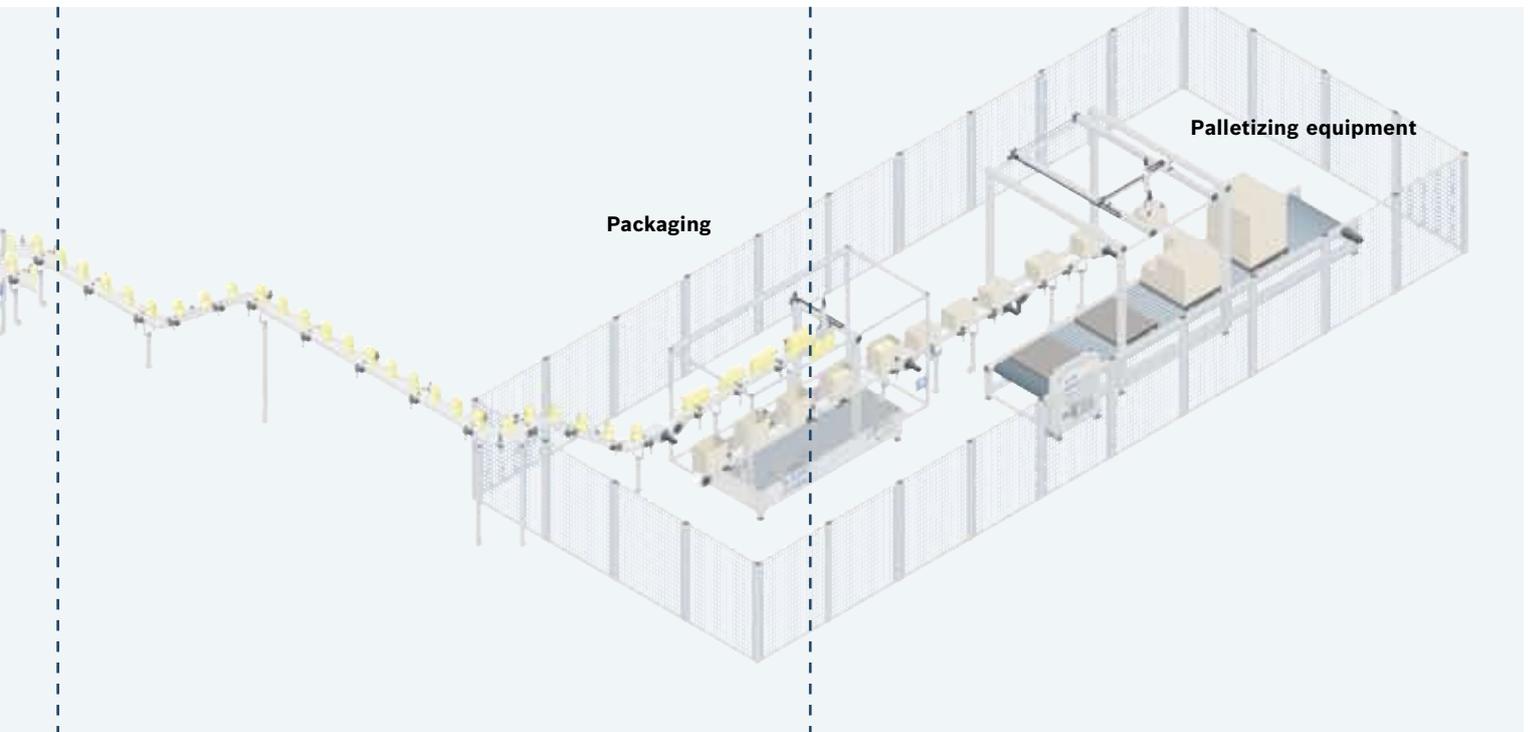
Food processing

- ▶ Non-contact gripping with NCT-PK series, made of PEEK, suitable for direct contact with food products
- ▶ ICS-D1 series cylinders, made of acid-proof steel, meet the highest requirements for hygienic design. NSF H1 lubrication
- ▶ CL03 series valve termin system with bus module and excellent protection class IP69K. EHEDG-certified hygienic design
- ▶ QR2 series fittings made of acid-proof stainless steel

Primary packaging

- ▶ ICS-D2 series cylinders, made of stainless steel, fulfill the highest requirements for hygienic design. NSF H1 lubrication
- ▶ CPC series cylinders for work environments with temperatures from -40°C to +150°C
- ▶ ICL series cylinders, Clean Line for easy cleaning. NSF H1 lubrication
- ▶ CL03 series valve terminal system with multipole plug, protection class IP69K. NSF H1 lubrication





Secondary packaging

- ▶ OCT series mini cylinders, with smooth surfaces and corrosion-resistant materials
- ▶ CCI series compact cylinders, non-rotating with front plate
- ▶ HF03-LG series valve terminal system, high flows with compact dimensions. High flexibility, since the same electronic modules can also be used with HF02-LG, HF04 and CD01-PI. NSF H1 lubrication

Final packaging

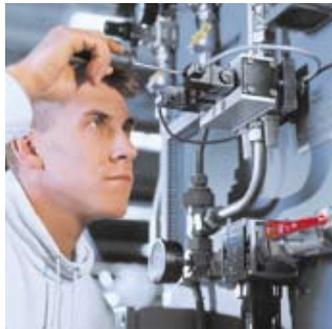
- ▶ PRA series cylinders – versatile with optimal pneumatic cushioning for ultimate performance and service life
- ▶ RTC-CG series rodless cylinders for high loads in a compact format
- ▶ Maintenance units from the AS family with a modular concept for all compressed air conditions. NSF H1 lubrication
- ▶ QR series fittings in numerous variants, standard or heat-resistant versions



Technological leadership and international market transparency

Profit from the experience of our international expert teams for product development and industry solutions!

As a global partner and expert in cross-cutting technologies, we can implement customized automation solutions tailored to your needs. From the project concept to commissioning, our experienced application technicians are available to support you with the special expertise required in the food & packaging industry – for engineering, selecting components, or configuring comprehensive application solutions.



And to keep it very simple, talk to our system technology specialists and let them develop and deliver a ready-to-install customized solution.

- ▶ Industry-specific product innovations
- ▶ Components with needs-based add-ons
- ▶ Components and overall solutions developed as customer-specific designs

Whether for ready-to-install configured modules, sub-systems, control panels and cabinets, complete handling systems or specific product adaptations – implementing customer-specific solutions has always been one of our core competencies.



NCT-PK series

One example of cutting-edge innovation is non-contact gripping with the NCT-PK series. The grippers are made of polyetheretherketone (PEEK), an extremely lightweight, stable, chemically neutral, high-tech plastic that is suitable for food products. It is also suitable for direct contact with foodstuffs and internationally approved. Only from Rexroth!

In dialog with our customers and partners

Based on proven expertise and a first-class product range

Our understanding of cooperation goes well beyond the boundaries of individual projects. We are constantly in dialog with our customers and are always a competent contact for both technical and economic questions. The know-how contained in our comprehensive pneumatic product range gives us a solid foundation for our work.

- ▶ Cylinders and sensor technology
- ▶ Valves, valve terminal systems, field bus connections
- ▶ Gripper and vacuum technology
- ▶ Compressed air preparation, assembly material, accessories

Understanding our customers allows us to respond more quickly and gives us a head start in achieving tailor-made solutions. Thus, we always remain close to the action and ensure the technological lead for us and our customers.



Around-the-clock information

The Rexroth Internet Portal never sleeps. In the online catalog, you can find additional information covering the entire product range, including all technical details, as well as the use of user-friendly design tools.

- ▶ Online catalog with product highlights in pneumatics
- ▶ Internet platform with online tools

 A screenshot of the Rexroth website's 'Food and Packaging' section. The page features a navigation menu on the left, a main content area with images of food products, and a sidebar with 'All Applications'. A small inset image shows a coffee machine with two cups of coffee.

www.boschrexroth.com/packaging

Industry-specific product range

A screenshot of the Rexroth website's 'Pneumatics' section. The page features a navigation menu on the left, a main content area with product highlights, and a sidebar with 'Engineering Tools'. The main content area includes a grid of product images and sections for 'Product Highlights', 'Standard Components', and 'Customized Solutions'.

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The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The given information does not release the user from the obligation of own judgement and verification. It must be remembered that our products are subject to a natural process of wear and aging.