Quality...
an absolute and total commitment

Everybody talks about quality.
We prefer to talk about the many components that work together to create a quality system that ensures excellence, not only in the final product but throughout the entire business process.
Research, technological innovation, training, respect for personnel, employee and environmental safety, and total customer care are all factors that Camozzi considers strategic in the achievement of quality reflecting an unyielding commitment to the pursuit of excellence.

ISO 9001
Day by day we try to improve ourselves, to extend our competence and our professionalism in a constant way.

Mandatory directives

- Directive 99/34/EC concerning liability for defective products modified by Legislative Decree 02/02/01 n° 25.
- Directive 2014/35/EU “Equipment designed for use within certain voltages”.
- Directive 2014/30/EU “Electromagnetic Compatibility EMC” and repealing Directive 89/336/EEC.
- Directive 2014/34/EU “Atex”.
- Directive 2006/42/EC “Machi nery”.
- Directive 2014/68/EU “Pressure equipment - PED”.
- Directive 2001/95/EC “General product safety”.
- Regulation 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Company with Integrated Management System certified by DNV

ISO 9001 - ISO 14001

One of Camozzi's main goals, besides quality and safety, is the protection of the environment and compatibility of our activities with the territorial context in which they are performed.
Since 1993 Camozzi has been certified according to the ISO 9001 standard and in 2003 the company obtained the ISO 14001 certification.
In the same year, DNV certified the Integrated Management System including both standards. Moreover, in 2013 Camozzi spa obtained the ISO/TS 16949 certification for the C-Truck fittings.

In 2013 Camozzi obtained the voluntary certification of its Quality Management System as "Intermediate stage of manufacture" in compliance with the requirements set out in attachment VII, section 3 of the 93/42/EEC Medical Devices Directive for the production and final testing of pressure control valves for fluids in haemodialysis equipment.

From the 1° July 2003, all products commercialised in the European Union and destined to be used in potenially explosive areas, should be approved according directive 94/9/CE better know as ATEX.
This new directive involves also the non electrical parts, as for instance pneumatic commands which should be approved.
As from 19 April 2016 the Atex Directive is replaced by the new directive 2014/34/EU.

ISO 14001
Minimise the consumption of energy, water, raw material and the production of waste, and focus on recycling wherever possible.

Technical standards

- ISO 4414 - Pneumatic fluid power - General rules relating to systems.

Environmental notes

- Packaging: we respect the environment, using materials which can be recycled. The packaging consists of plastic bags which are recyclable PE and paper.
- Green Design Project: in the study of new products, the environmental impact is always taken into consideration (real project, elaboration, etc.).

Information for the use of Camozzi products

In order to guarantee a proper functioning of its products, Camozzi S.p.A. herewith provides some general information.

Air quality

Beyond respecting the limit values as pressure, force, speed, voltage, temperature and others values that are indicated in the general tables of each product, another aspect to consider is the quality of the compressed air. While resources as electricity, water and gas are normally supplied by external companies that guarantee the standard, air is produced inside a company and therefore it's the user that has to guarantee its quality.

This characteristic is essential for a proper functioning of pneumatic systems. One m³ of air at the atmospheric pressure contains various substances:
- more than 150 million of solid particles with dimensions from 0,01 μm to 100 μm,
- fumes due to combustion,
- water vapour, which quantity depends from the temperature, at 30° there are about 30 g/m³ of water
- oil, up to about 0,03 mg
- micro organisms
- as well as different chemical contaminants, odours etc …

Compressing the air, in the same volume of 1 m³, we find "n" m³ of air, therefore the substances indicated before increase.
In order to limit this, at the inlet and outlet of the compressors filters, driers and oil separators are installed.
In spite of these precautions, the air, during its transport inside tubes or storage in tanks, can collect flakes of rust, a part of the water vapour contained in the air, cooling down, can pass from a gaseous state into a liquid state, but can also transform the oil fumes that were not retained by the previous filters.
For this reason it is advisable to equip the systems or machinery with air treatment groups.

Air treatment: classification according to ISO 8573-1-2010 standard

ISO 8573-1-2010 Class	Solid particles: Max. Number of Particles per m³ 0,1 - 0,5 μm	0,5 - 1 μm	1 - 5 μm	Solid particles: Max Concentration mg/m³	Water: Water pressure dew point °C	Water: Liquid g/m³	Oil: Total content (liquid, aerosol and vapour) mg/m³
0	More strict than class 1, defined by the device user						
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	-

These groups can have different functions: isolation valves, pressure regulators, soft-start valves and of course filters.
Only in some applications, lubricators are still used.
Regarding filtering, there are standards of reference as ISO 8573-1-2010 that classify air according to its quality.
This standard defines the relevant class of compressed air according to the presence of three contaminating categories: solid parts, water or water vapour, concentration of micro mist or oil vapours.
In general, if not specified otherwise in the characteristics of the single component, the Camozzi products require an **ISO 8573-1-2010 class 7-4-4** air quality, this wording indicates that:

class 7
A maximum concentration of solid particles of 5 mg/m³ is allowed and the dimension is not declared.
The standard Camozzi filters are declared as class 7 even if the filtering elements are realized with a technology that enables to separate solid particles with a dimension of more than 25 μm.
The air exiting from our filters and therefore the air at the inlet of all other components can contain solid particles with a maximum concentration of 5 mg/m³ but with a maximum dimension of 25 μm.

class 4
The temperature has to arrive at ≤ 3° in order for the water vapor to condense and become liquid.

The classical filters have characteristics that separate the humidity in the air only if it is in a liquid state or nearly.
It is the cooling of the air that enables condensation and then the elimination of the water present in the form of water vapour.
The air flow entering the bowl of the filter sustains a minimum expansion phase, (according to the gas law when gas sustains a sudden expansion its temperature lowers) followed by a vortex, this enables the heavier particles and the water vapour, that is condensed due to the expansion, to adhere to the sides of the bowl and slide down towards the drainage system.
Except for specific versions, the Camozzi filters are declared to be in class 8.
This means that the user has to provide in installing driers in its compressed air production system that, by cooling the air, dehumidify it.

class 4
The concentration of oily parts must be of maximum 5 mg/m³.
The compressors use oil that during the process can be introduced into the system in the form of aerosol, vapour or liquid.
This oil, as all other pollutants, is transported by the air into the pneumatic circuit, enters in contact with the seals of the components and subsequently in the environment through the outlets of the solenoid valves. In this case coalescing filters are used that have an operating principle and filtering cartridges that are different compared to others and this allows to aggregate those micro-molecules of oil suspended in the air and remove them.
The Camozzi coalescing filters enable to reach classes 2 and 1.
It is important to keep in mind that the best performance is reached only by means of a filtering process with subsequent phases.

As illustrated, there are filters with different characteristics, a very efficient filter for a certain contaminant, but may not be so for other contaminants.
The filtering elements determine the class of the filters, these elements should be replaced after a certain period or after a certain number of working hours.
These parameters vary according to the characteristics of the incoming air.

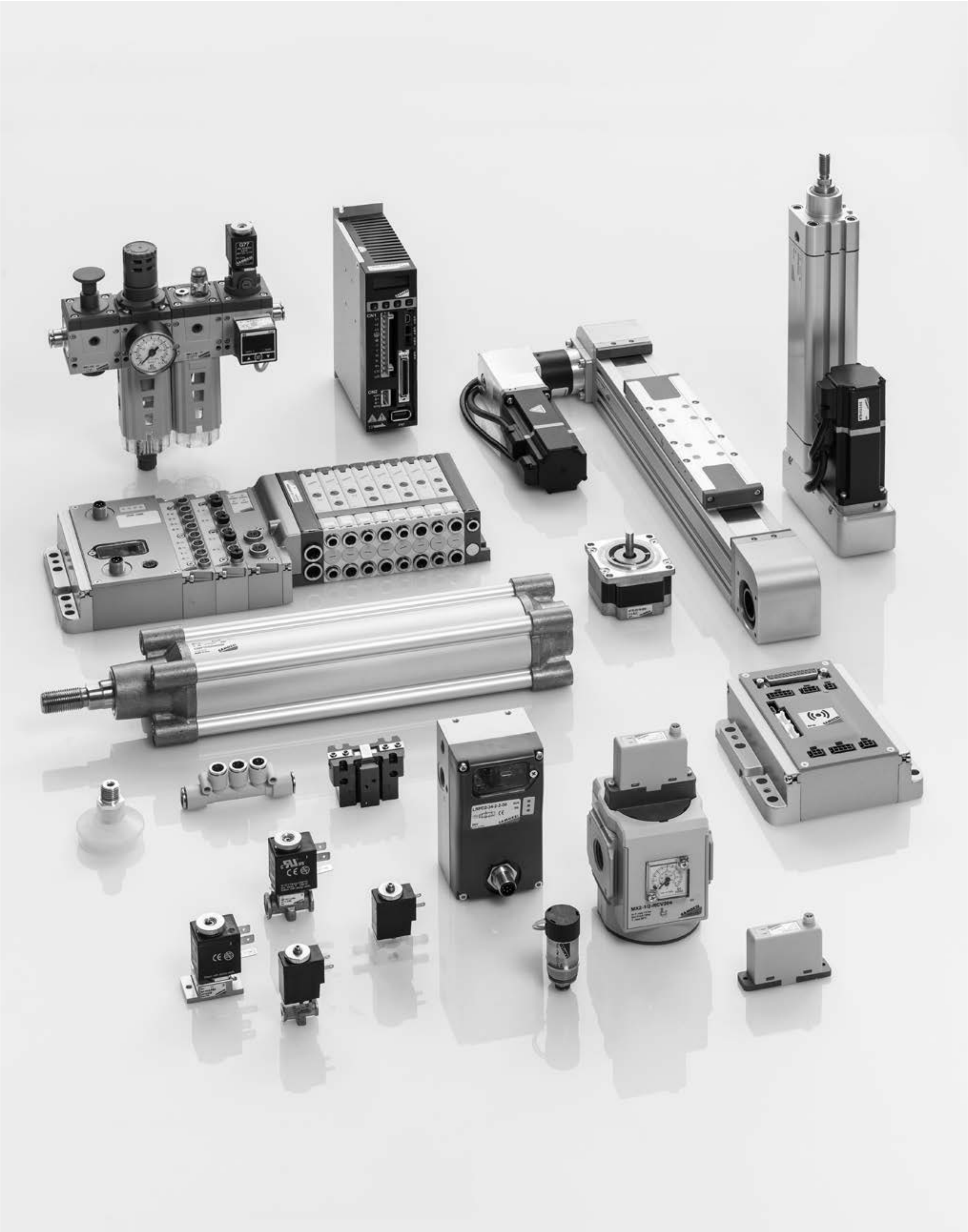
The Camozzi filters are subdivided into different groups:
- Filtering element of 25 μm, class 7-8-4
- Filtering element of 5 μm, class 6-8-4
- Filtering element of 1 μm, class 2-8-2 with pre-filter class 6-8-4
- Filtering element of 0,01 μm, class 1-8-1 with pre-filter class 6-8-4 residual oil content of 0,01 mg/m³
- Activated carbon, class 1-7-1 with pre-filter class 1-8-1 residual oil content of 0,003 mg/m³

The components are previously greased with special products and do not need an additional lubrication. In case it should be necessary, use ISO VG 32 oil.
The quantity of oil introduced into the circuit depends on the different applications, we suggest a dosage of max. 3 drops per minute.

Pneumatic cylinders

The choice of the correct cylinder mounting to the structure and also that of the rod attachment to any moving parts, are as important as the control of parameters relating to speed, mass and radial loads. The control of these parameters has to be guaranteed by the user. The location of position sensors (reed switches), and their switching response times to magnetic fields, is dependant upon the type and bore size of cylinder and the appropriate precautions need to be taken when fixing these items.
(see notes on the pages relative to the sensors).

We do not advise the use of a cylinder application as a shock absorber or as pneumatic cushioning. If used at the maximum speed, we recommend gradual deceleration to avoid a violent impact between piston and the cylinder end cover.
As a general value, we calculate a maximum average speed of 1 m/sec.
In this case no lubrication is required as the lubrication introduced during assembly is sufficient to guarantee good operation.
If faster speeds are required, we suggest lubrication in the quantities described above.



Directive ATEX 2014/34/EU: products classified for the use in potentially esplosive atmospheres

ATEX
2014/34/EU

As from 19 April 2016 all products which are commercialised in the European Union and destined to be used in **potentially explosive atmospheres** have to be approved according to the directive 2014/34/EU, also known as ATEX.
This new directive also refers to non-electric items, like pneumatic drives, which need to be approved.

These are the main changes introduced by the new directive 2014/34/EU:
- Also non-electric apparatus and devices, as pneumatic cylinders, are part of the Directive
- The apparatus are assigned to different categories which are assigned to certain potentially explosive zones.
- The products are identified with the CE mark Ex.
- The instructions for use and the declarations of conformity should in order to be supplied with each sold product used in potentially explosive zones.
- Products destined to be used in potentially explosive zones, because of the presence of dust, are included in the directive like the products destined to be used in zones with the presence of dangerous gases.

A potentially explosive atmosphere could be composed of gas, mist, steam or dust which can be created in manufacturing processes or in all those areas in which there is a constant or random presence of inflammable substances.
An explosion can occur when there is an existing presence of inflammable substances and an ignition source in a potentially explosive atmosphere.

An ignition source could be:
- Electrical (electric arcs, induced current, heat generated by the Joule effect)
- Mechanical (heat between surfaces caused by friction, sparks generated by the collision of metallic bodies, electrostatic discharges, adiabatic compression)
- Chemical (exothermic reactions between materials)
- Naked flames.

The products which are subject to the approval are those which, during their normal use or because of a malfunction, present one or more ignition sources for the potentially explosive atmospheres.

The producer has to guarantee that the product conforms with the declarations and to the marking of the product.
Moreover the product should always be accompanied by the relative instructions.
The builder of the equipment and/or user should identify the risk zone in which the products, to which directive 99/92/CE refers, are used and purchase the product according to the use in the pre-determined zone paying attention to the specifications in the relative instructions.

In case a product is composed by two components with different markings, the component which is classified in the lowest category defines the class to which the complete product belongs.

Example:
solenoid suitable for Category 3 marked …
Ex - II 3 EEx…

and valve suitable for Category 2 …
Ex - II 2 EEx…
The valve unit with solenoid can be used only in category 3 or zone 2/22.

Zones, groups and categories

In the places and for the types of equipment subject to Directive 99/92/CE, the employer should execute the classification of the zones regarding the danger of the creation of explosive atmospheres because of the presence of gas or dust.

The apparatus for the use in potentially explosive zones are divided in GROUPS:

GROUP I > apparatus used in mines

GROUP II > apparatus used in installations above the ground

Group I: Apparatus used in mines

CATEGORY M1
Functioning in explosive atmospheres

CATEGORY M2
Non-supplied equipment in explosive atmospheres

Group II: Apparatus for installations above the ground

Product category	GAS	DUST
1	Zone 0	Zone 20
2	Zone 1	Zone 21
3	Zone 2	Zone 22

Classification of zones according to Directive 99/92/CE

Category 1	Zone 0 -	Area in which (permanently, for long periods or often) an explosive atmosphere is present, consisting of a mixture of air and inflammables in the form of gas, vapour or mist.
	Zone 20 -	Area in which (permanently, for long periods or often) an explosive atmosphere is present in the form of a dust/powder cloud which is combustible in the air.
Category 2	Zone 1 -	Area in which, during normal activities, the formation of an explosive atmosphere is probable, consisting of a mixture of air and inflammables in the form of gas, vapours or mist.
	Zone 21 -	Area in which occasionally during normal activities the formation of an explosive atmosphere is probable, in the form of a dust cloud which is combustible in the air.
Category 3	Zone 2 -	Area in which, during normal activities, the formation of an explosive atmosphere, consisting of a mixture of air and inflammables in the form of gas, vapour or mist is not probable and, whenever this should occur, it is only of a short duration.
	Zone 22 -	Area in which, during normal activities, the formation of an explosive atmosphere in the form of a combustible dust cloud is not probable and, whenever this should occur, it is only of a short duration.

Example of Marking: Ex II 2 GD c T100°C (T5) -20°C≤Ta≤60°C

II	Group: Devices which are to be used in spaces exposed to risks of an explosive atmosphere, different from underground spaces, mines, tunnels, etc., individuated according to the criteria in enclosure I of the Directive 2014/34/EU (ATEX).
2	Category: Devices designed to function in compliance with the operational parameters determined by the manufacturer and guarantee a high protection level.
GD	Qualification gas and dusts: Protected against gas (G) and explosive dusts (D).
c	Non-electrical devices: Non-electrical devices for potentially explosive atmospheres. Protection through constructive security.
T 100°C	Max. temperature for components for dusts: Max. superf. temp. of 100°C regarding potential hazards resulting from striking within the vicinity of hazardous dusts.
T5	Max. temperature for components for gas: Max. superf. temp. of 100°C regarding potential hazards which may result from striking within gasy environments.
Ta	Environmental temperature: **-20°C≤Ta≤60°C.** Environmental temperature range (with dry air).

Group I: Temperature classes

Temperature = 150°C
or = 450°C according to the level
of dust on the apparatus.

Group II: Temperature classes

Temp. classes for gas (G)	Admissible surface temperatures
T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C
T6	85°C

ATEX certified Camozzi products

APPARATUS regarding ATEX - Group II

Cylinders

Series	Category	Zone	Gas/Dust
16*	2 DE-3 SE	1/21 DE -2/22 SE	G/D
24*	2 DE-3 SE	1/21 DE-2/22SE	G/D
25*	2 DE-3 SE	1/21 DE-2/22SE	G/D
31-32	2 DE-3 SE	1/21DE-2/22SE	G/D
31-32 Tandem/multi-position	2 DE	1/21 DE	G/D
40*	2 DE	1/21 DE	G/D
41*	2 DE	1/21 DE	G/D
60*	2 DE-3 SE	1/21DE-2/22 SE	G/D
61*	2 DE-3 SE	1/21DE-2/22 SE	G/D
62*	2 DE	1/21 DE	G/D
27	2 DE	1/21 DE	G/D
QP-QPR	2 DE-3 SE	1/21DE-2/22 SE	G/D
QN	3 SE	2/22 SE	G/D
42	2 DE-3 SE	1/21DE-2/22 SE	G/D
ARP	2	1/21	G/D
CSH/CST/CSV	3	2/22	G/D

Solenoids

Series	Category	Zone	Gas/Dust
U70	3	2/22	G/D
H80	2	1/21	G/D
H80I**	2	1/21	G/D

Pressure switches

Series	Category	Zone	Gas/Dust
PM 11**	1	0/20	G/D

Valves

Series	Category	Zone	Gas/Dust
9#*	2	1/21	G/D
K	3	2/22	G/D
P	3	2/22	G/D
W	3	2/22	G/D
A#	2	1/21	G/D
3#	2	1/21	G/D
4#	2	1/21	G/D
NAMUR#	2	1/21	G/D
E (pneumatic)	2	1/21	G/D
E (electro-pneumatic)	3	2/22	G/D
Y	3	2/22	G/D
2	2	1/21	G/D

FRL

Series	Category	Zone	Gas/Dust
MC#	2	1/21	G/D
N	2	1/21	G/D
MX#	2	1/21	G/D
T	2	1/21	G/D
CLR	2	1/21	G/D
M	2	1/21	G/D

* According to ISO standard
** Products with ATEX and IECEX certification
# Without solenoid

DE = Double-acting cylinder
SE = Single-acting cylinder

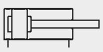
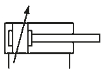
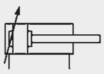
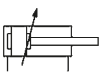
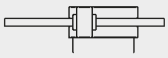
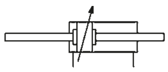
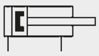
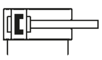
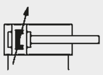
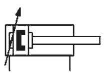
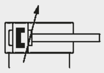
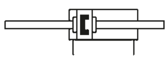
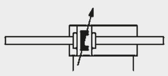
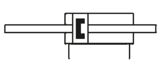
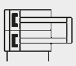
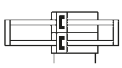
COMPONENTS regarding ATEX - Group II

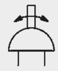
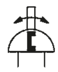
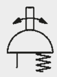
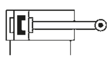
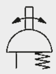
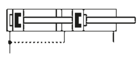
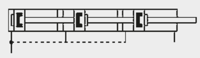
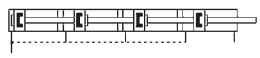
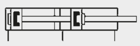
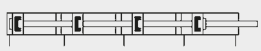
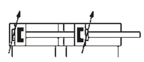
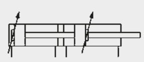
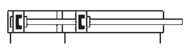
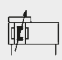
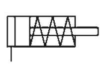
Products	Category	Zone	Gas/Dust
Silencers	2	1/21	G/D
Quick release couplings	2	1/21	G/D
Manifolds	2	1/21	G/D
Subbases	2	1/21	G/D
Feet	2	1/21	G/D
Caps	2	1/21	G/D
Plates	2	1/21	G/D

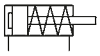
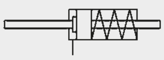
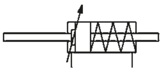
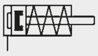
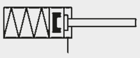
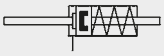
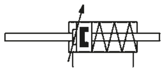
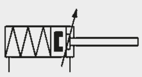
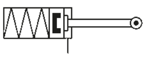
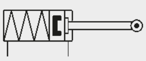
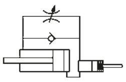
» The order code number of the certified products is obtained by adding "EX" to the standard article number
Es. 358-015 standard solenoid valve
Es. 358-015EX ATEX certified solenoid valve

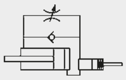
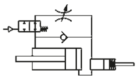
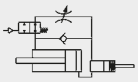
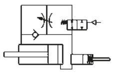
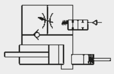
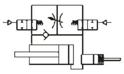
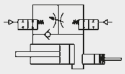
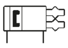
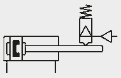
Accessories available in category 2 zone 1/21: couplings, junctions, brackets, piston rod nuts, nuts, counter brackets, bushings, pins, clevis pins, caps, gaskets, diaphragm, sub-bases, plates, feet, hand operated valves, flow valves, flanges, screw, tie rods, automatic and blocking valves, silencers and pressure gauge, connector kits, clamps, rapid and super rapid push-in fittings, hoses, sealing rings, locking nuts. Accessories available in category 3, zone 2/22: adaptors, slot covers, extensions, connectors. For more informations on this kind of products see the website: http://catalogue.camozzi.com within the section: Downloads > Certifications > ATEX Directive 2014/34/EU > List of products excluded from the directive 2014/34/EU ATEX.

Pneumatic symbols

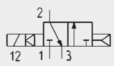
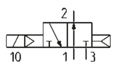
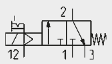
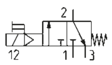
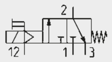
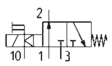
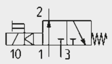
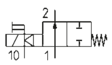
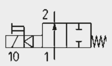
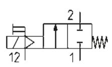
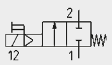
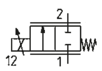
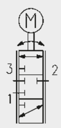
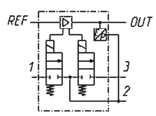
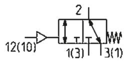
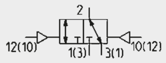
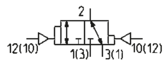
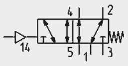
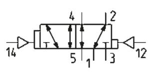
Symbol		Type
		CYLINDERS
CD01		Double-acting cylinder, fixed cushions
CD02		Double-acting cylinder, cushioned
CD03		Double-acting cylinder, adjustable rear cushion
CD04		Double-acting cylinder, adjustable front cushion
CD05		Double-acting cylinder, through-rod, fixed cushions
CD06		Double-acting cylinder, through-rod, adjustable front and rear cushion
CD07		Double-acting cylinder, magnetic
CD08		Double-acting cylinder, magnetic, fixed cushions
CD09		Double-acting cylinder, magnetic, adjustable cushions in both directions
CD10		Double-acting cylinder, magnetic, adjustable rear cushion
CD11		Double-acting cylinder, magnetic, adjustable front cushion
CD12		Double-acting cylinder, magnetic, through-rod, fixed cushions
CD13		Double-acting cylinder, magnetic, through-rod, adjustable cushions in both directions
CD14		Double-acting cylinder, magnetic, through-rod
CD15		Magnetic twin rod cylinders
CD16		Magnetic twin through-rod cylinders

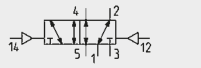
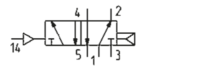
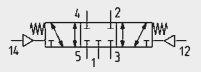
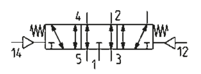
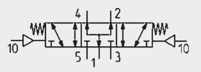
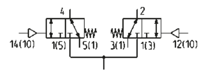
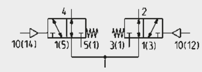
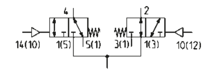
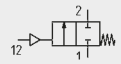
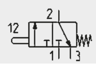
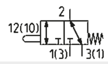
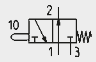
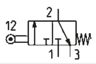
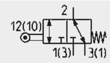
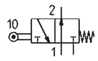
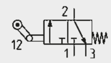
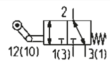
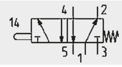
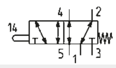
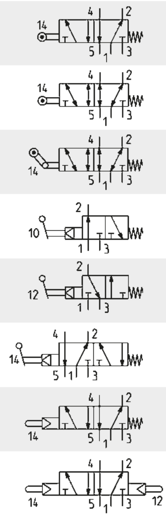
Symbol		Type
		CYLINDERS
CD17		Double-acting rotary cylinder
CD18		Double-acting rotary cylinder, magnetic
CD19		Single-acting rotary cylinder
CD20		Magnetic double-acting cylinder with fixed cushions, rod, roller
CD21		Single-acting rotary cylinder
CD2T		Magnetic tandem cylinder, two stages, fixed cushions single rear supply, sole front supply
CD3T		Magnetic tandem cylinder, three stages, fixed cushions single rear supply, sole front supply
CD4T		Magnetic tandem cylinder, four stages, fixed cushions single rear supply, sole front supply
CD5T		Magnetic tandem cylinder, two stages, fixed cushions, separated rear supplies, sole front supply
CD6T		Magnetic tandem cylinder, three stages, fixed cushions, single rear supplies, sole front supply
CD7T		Magnetic tandem cylinder, two stages, fixed cushions, single rear supplies, sole front supply
CD8T		Magnetic tandem cylinder, two stages, fixed cushions, separated rear and front supplies
CD9T		Non magnetic tandem cylinder, two stages, fixed cushions, separated rear and front supplies
CDPP		Magnetic multi-position cylinder, fixed cushions
CDSS		Double-acting rodless cylinder, magnetic
CS01		Single-acting cylinder, front spring

Symbol		Type
		CYLINDERS
CS02		Single-acting cylinder, front spring
CS03		Single-acting cylinder, non cushioned
CS04		Single-acting cylinder, through-rod
CS05		Single-acting cylinder, through-rod, adjustable cushion
CS06		Single-acting cylinder, magnetic
CS07		Single-acting cylinder, front spring, adjustable rear cushion
CS08		Single-acting cylinder, rear spring, magnetic
CS09		Single-acting cylinder, magnetic, front spring
CS10		Single-acting cylinder, through-rod
CS11		Single-acting cylinder, through-rod, adjustable rear cushion
CS12		Single-acting cylinder, front spring, adjustable rear cushion
CS13		Single-acting cylinder, through-rod, adjustable rear cushion
CS14		Single-acting cylinder with adjustable front cushion and rear connection
CS15		Magnetic single-acting cylinder, rear spring, rod, roller
CS16		Magnetic double-acting cylinder, rear spring, rod, roller
HI01		Hydrocheck, regulated rod thrust

Symbol		Type
		CYLINDERS
HI02		Hydrocheck, regulated rod return
HI03		Hydrocheck, regulated rod thrust with stop valve
HI04		Hydrocheck, regulated rod return with stop valve
HI05		Hydrocheck, regulated rod thrust with skip valve
HI06		Hydrocheck, regulated rod return with skip valve
HI07		Hydrocheck, regulated rod thrust with skip and stop valve
HI08		Hydrocheck, regulated rod return with skip and stop valve
PNZ1		Double-acting magnetic grippers
PNZ2		Magnetic single-/double-acting grippers, front spring
PNZ3		Magnetic single-/double-acting grippers, rear spring
PNZ4		Non magnetic single-acting grippers, rear spring
PNZ5		Magnetic single-acting grippers, rear spring
RDLK		Rod lock device

Symbol	Type
	SOLENOID VALVES
EV01	Directly operated solenoid valve, 2/2 NC
EV02	Directly operated solenoid valve, 2/2 NO
EV03	Directly operated solenoid valve, 3/2 NC
EV04	Directly operated solenoid valve, 3/2 NC, monostable, with manual override
EV05	Directly operated solenoid valve, 3/2 NO
EV06	Directly operated solenoid valve, 3/2 NO, monostable, with manual override
EV07	Solenoid valve, 3/2 NC with quick exhaust
EV08	Directly operated solenoid valve, 3/2 NC, bistable, with manual override
EV09	Directly operated solenoid valve, 3/2 NO, bistable, with manual override
EV10	Solenoid valve, 3/2 NC, monostable, with bistable manual override
EV11	Solenoid valve, 3/2, monostable, solenoid pilot with separate air supply and bistable manual override
EV12	Solenoid valve, 3/2 NO, monostable, with bistable manual override
EV13	Solenoid valve, 3/2, monostable, solenoid pilot with separate air supply and bistable manual override
EV14	Solenoid valve, 3/2, bistable, with manual override bistabile
EV15	Solenoid valve, 3/2, bistable, solenoid pilot with separate air supply and bistable manual override
EV16	Solenoid valve, 3/2 NC, monostable, (pneumatic spring) and bistable manual override
EV17	Solenoid valve, 3/2 NO, monostable, (pneumatic spring) and bistable manual override
EV18	Solenoid valve, 5/2, monostable, with bistable manual override
EV19	Solenoid valve, 5/2, monostable, solenoid pilot with separate air supply and bistable manual override
EV20	Solenoid valve, 5/2, monostable, (pneumatic spring) and manual override
EV21	Solenoid valve, 5/2, monostable, (pneumatic spring) and bistable manual override
EV22	Solenoid valve, 5/2, monostable, solenoid pilot with separate air supply, pneumatic spring and bistable manual override
EV23	Solenoid valve, 5/2, bistable, with bistable manual override
EV24	Solenoid valve, 5/2, bistable, with manual override
EV25	Solenoid valve, 5/2, bistable, solenoid pilot with separate air supply and bistable manual override
EV26	Solenoid valve, 5/2, bistable, solenoid pilot with separate air supply and bistable manual override
EV27	Solenoid valve, 5/3 CC, with manual override
EV28	Solenoid valve, 5/3 CC, with bistable manual override
EV29	Solenoid valve, 5/3, solenoid pilot with separate air supply and bistable manual override
EV30	Solenoid valve, 5/3, solenoid pilot with separate air supply and bistable manual override
EV31	Solenoid valve, 5/3 CO, with manual override
EV32	Solenoid valve, 5/3 CO, with bistable manual override
EV33	Solenoid valve, 5/3 CO, solenoid pilot with separate air supply and bistable manual override
EV34	Solenoid valve, 5/3 CO, solenoid pilot with separate air supply and bistable manual override
EV35	Solenoid valve, 5/3 CP, with manual override
EV36	Solenoid valve, 5/3 CP, with bistable manual override
EV37	Solenoid valve, 5/3 CP, solenoid pilot with separate air supply and bistable manual override
EV38	Solenoid valve, 5/3 CP, solenoid pilot with separate air supply and bistable manual override
EV39	Double solenoid valve, 3/2 NC, monostable, with bistable manual override
EV40	Double solenoid valve, 3/2, monostable, solenoid pilot with separate air supply and bistable manual override
EV41	Double solenoid valve, 3/2 NO, monostable, with bistable manual override
EV42	Double solenoid valve, 3/2, monostable, solenoid pilot with separate air supply and bistable manual override
EV43	Double solenoid valve, 3/2 NC, NO, monostable, with bistable manual override
EV44	Double solenoid valve, 3/2, monostable, solenoid pilot with separate air supply and bistable manual override
EV45	Directly operated solenoid valve, 3/2, possible universal use, reversed printed ports 1 and 2 on the body
EV46	Indirectly operated solenoid valve, 2/2 NO
EV47	Directly operated solenoid valve, 2/2 NC, with linked diaphragm
EV48	Indirectly operated solenoid valve, 2/2 NC
EV49	Indirectly operated Booster solenoid valve, 2/2 NC
EV50	Indirectly operated Booster solenoid valve, 2/2 NO

Symbol	Type
	SOLENOID VALVES
EV51 	Indirectly operated Booster solenoid valve, 3/2 NC
EV52 	Indirectly operated Booster solenoid valve, 3/2 NO
EV53 	Pneumatic solenoid valve, 3/2 NC, monostable, with separated solenoid pilot supply and bistable manual override
EV54 	Pneumatic solenoid valve, 3/2 NC, monostable, with monostable manual override
EV56 	Pneumatic solenoid valve, 3/2 NC, monostable, with separated solenoid pilot supply and monostable manual override
EV57 	Pneumatic solenoid valve, 3/2 NO, monostable, with separated solenoid pilot supply and monostable manual override
EV58 	Pneumatic solenoid valve, 3/2 NO, monostable, with monostable manual override
EV59 	Pneumatic solenoid valve, 2/2 NO, monostable, with separated solenoid pilot supply and monostable manual override
EV60 	Pneumatic solenoid valve, 2/2 NO with monostable manual override
EV61 	Pneumatic solenoid valve, 2/2 NC, monostable, with separated solenoid pilot supply and monostable manual override
EV62 	Pneumatic solenoid valve, 2/2 NC with monostable manual override
	PROPORTIONAL VALVES
ER01 	Proportional regulator
AP01 	Directly operated proportional valve
LR1 	Servo valves
K8P1 	Series K8P proportional micro-valve
	PNEUMATICALLY OPERATED VALVES
VP01 	Pneumatically operated valve, 3/2, monostable, mechanical spring
VP02 	Pneumatically operated valve, 3/2, bistable
VP03 	Pneumatically operated valve, 3/2, preferential
VP04 	Pneumatically operated valve, 5/2, monostable, mechanical spring
VP05 	Pneumatically operated valve, 5/2, preferential

Symbol	Type
	PNEUMATICALLY OPERATED VALVES
VP06 	Pneumatically operated valve, 5/2, bistable
VP07 	Pneumatically operated valve, 5/2, monostable, pneumatic spring
VP08 	Pneumatically operated valve, 5/3 CC
VP09 	Pneumatically operated valve, 5/3 CO
VP10 	Pneumatically operated valve, 5/3 CP
VP11 	Pneumatically operated double valve, 3/2, monostable
VP12 	Pneumatically operated double valve, 3/2, monostable
VP13 	Pneumatically operated double valve, 3/2, monostable
VP14 	Indirect pneumatically operated valve, 2/2, monostable
	MECHANICALLY OPERATED VALVES
VM01 	Mechanically operated valve, plunger actuation, 3/2 NC, monostable, mechanical spring
VM02 	Mechanically operated valve, plunger actuation, 3/2, monostable, mechanical spring
VM03 	Mechanically operated valve, plunger actuation, 3/2 NO, monostable, mechanical spring
VM04 	Mechanically operated valve, lever/roller actuation, 3/2 NC, monostable, mechanical spring
VM05 	Mechanically operated valve, lever/roller actuation, 3/2, monostable, mechanical spring
VM06 	Mechanically operated valve, lever/roller actuation, 3/2 NO, monostabile, mechanical spring
VM07 	Mechanically operated valve, unidirectional lever actuation, 3/2 NC, monostable, mechanical spring
VM08 	Mechanically operated valve, unidirectional lever actuation, 3/2 monostable, mechanical spring
VM09 	Mechanically operated valve, plunger actuation, 5/2, monostable, mechanical spring
VM10 	Mechanically operated valve, plunger actuation, 5/2, monostable, mechanical spring
VM11 	Mechanically operated valve, lever/roller actuation, 5/2, monostable, mechanical spring
VM12	Mechanically operated valve, lever/roller actuation, 5/2, monostable, mechanical spring
VM13	Mechanically operated valve, unidirectional lever actuation, 5/2, monostable, mechanical spring
VM14	Mechanically operated sensor valve, 3/2 NO, monostable, mechanical spring
VM15	Mechanically operated sensor valve, 3/2 NC, monostable, mechanical spring
VM16	Mechanically operated sensor valve, plunger actuation, 5/2, monostable, mechanical spring
VM17	Mechanically operated sensor valve, 5/2, monostable, mechanical spring
VM18	Mechanically operated sensor valve, plunger actuation, 5/2, bistable

Symbol	Type
	MECHANICALLY OPERATED VALVES
VM19	Mechanically operated sensor valve, lever/roller actuation, 5/2, monostable, mechanical spring
VM20	Mechanically operated sensor valve, lever/roller actuation, 5/2, bistable
VM21	Mechanically operated valve, front actuation, 5/2 NC, monostable, mechanical spring
	MANUALLY OPERATED VALVES
VN01	Manually operated valve, 3/2, bistable
VN02	Manually operated valve, 3/2, bistable, lockable in two positions
VN03	Manually operated valve, 3/2, bistable
VN04	Manually operated valve, 3/2 NC, monostable, mechanical spring
VN05	Manually operated valve, 3/2 NO, monostable, mechanical spring
VN06	Manually operated valve, 3/2, monostable, mechanical spring
VN07	Manually operated lever valve, 3/2, bistable
VN08	Manually operated lever valve, 3/2, bistable
VN09	Manually operated lever valve, 3/2 NC, monostable, mechanical spring
VN10	Manually operated lever valve, 3/2, bistable
VN11	Manually operated lever valve, 3/2, monostable, mechanical spring
VN12	Pedal operated valve, 3/2 NC, monostable, mechanical spring
VN13	Manually operated valve, 5/2, bistable
VN14	Manually operated valve, 5/2, monostable, mechanical spring
VN15	Manually operated lever valve, 5/2, bistable
VN16	Manually operated lever valve, 5/2, bistable
VN17	Manually operated lever valve, 5/2, monostable, mechanical spring
VN18	Pedal operated valve, 5/2, bistable
VN19	Pedal operated valve, 5/2, monostable bistable
VN20	Manually operated lever valve, 5/3 CC, stable
VN21	Manually operated lever valve, 5/3 CC, monostable

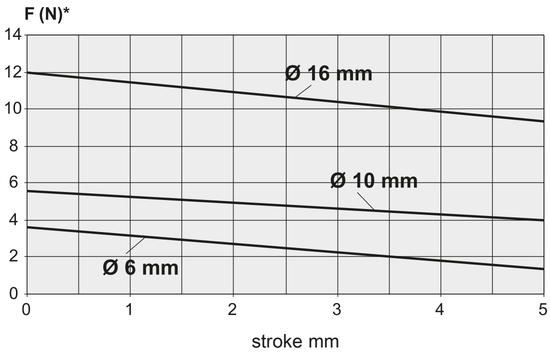
Symbol	Type
	MANUALLY OPERATED VALVES
VN22	Manually operated lever valve, 5/3 CO, stable
VN23	Manually operated lever valve, 5/3 CO, stable
VN24	Manually operated lever valve, 5/3 CO, monostable
VN25	Manually operated lever valve, Joystik
	PNEUMATIC LOGIC VALVES
AND1	“AND” pneumatic symbol
AND2	“AND” logical symbol
OR01	“OR” pneumatical symbol and circuit selector
OR02	“OR” logical symbol
YES1	“YES” pneumatic symbol
YES2	“YES” logical symbol
NOT1	“NOT” pneumatic symbol
NOT2	“NOT” logical symbol
MEM1	“MEMORY” pneumatic symbol
MEM2	“MEMORY” logical symbol
AMP1	Signal amplifier, 3/2 NC, mechanical spring return
2LB1	Jet interruption sender sensor
2LB2	Jet interruption receiver sensor
	AUTOMATIC VALVES
VMP1	Maximum pressure valve
VSC1	Quick exhaust valves
VBU1	Unidirectional blocking valves
VB01	Bidirectional blocking valves
VNR1	Non return valves

Symbol	Type
	AUTOMATIC VALVES
VNV1	Check valve
	FLOW CONTROL VALVES
RFU1	Unidirectional flow control valve
RFO1	Bidirectional flow control valve
RP01	Unidirectional flow control valve
RP02	Unidirectional flow control valve
RP03	Bidirectional flow control valve
	PRESSURE SWITCHES AND VACUUM SWITCHES
PMNA	Pressure switch, Normally Open (NO)
PMNC	Pressure switch, Normally Closed (NC)
PMSC	Pressure swith with exchange contacts
PMTV	Pressure switch with setting visual scale
TRP1	Electro-pneumatic transducer
SEG1	Pressure indicator
CAP1	Capacity
	SILENCIER
SIL1	Silencier
RSW1	Silenced exhaust controller
	FRL
FT01	Filter without drain
FT02	Filter with manual drain
FT03	Filter with automatic drain
FA01	Coalescing filter without drain
FA02	Coalescing filter with manual drain
FA03	Coalescing filter with automatic drain
FC01	Absorption function without cup hole

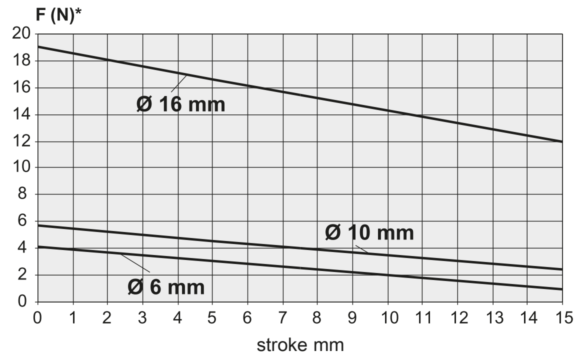
Symbol	Type
	FRL
PR01	Regulator without relieving
PR02	Regulator with relieving
PR03	Regulator with relieving and by-pass valve
PR04	Regulator without relieving and with by-pass valve
PR05	Regulator without relieving and with pressure gauge
PR06	Regulator with relieving and with pressure gauge
LU01	Lubricator
FR01	Filter-regulator with relieving and manual drain
FR02	Filter-regulator with relieving and without drain
FR03	Filter-regulator with relieving, manual drain and pressure gauge
FR04	Filter-regulator with relieving, without drain and with pressure gauge
FR05	Filter-regulator with relieving, manual drain and pressure gauge
FR10	Filter-regulator with manual drain, without relieving and with pressure gauge
FR11	Filter-regulator with manual drain and without relieving
FR18	Filter-regulator with relieving and automatic drain
FR19	Manifold pressure regulator
VN02	Lockable isolation valve
AVP1	Soft start valve
BL01	Take-off block
BL02	Take-off block with VNR
	VACUUM
VU01	In-line ejector
VU02	Silenced in-line ejector
VEN1	Suction pad
FT04	Cup filter

Spring loads cylinders

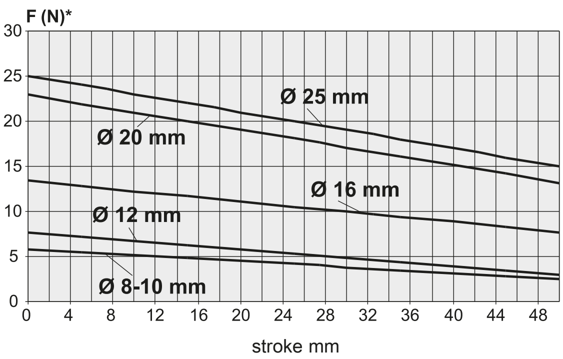
Series 14 - stroke 5 mm



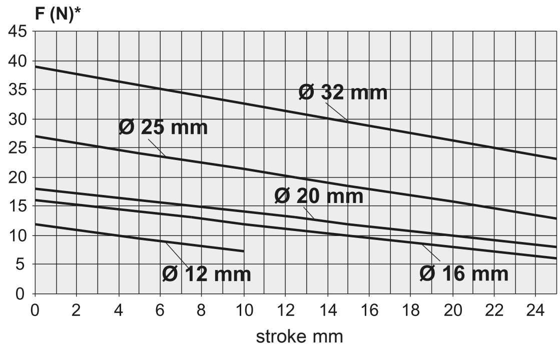
Series 14 - stroke 10 and 15 mm



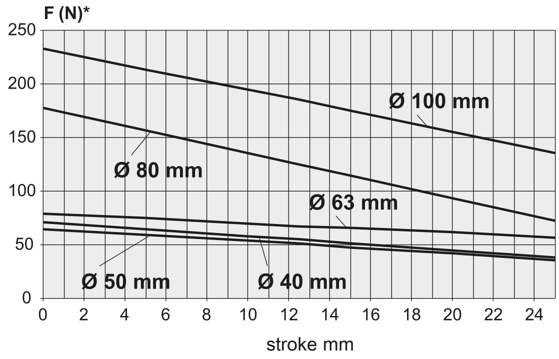
Series 16-24



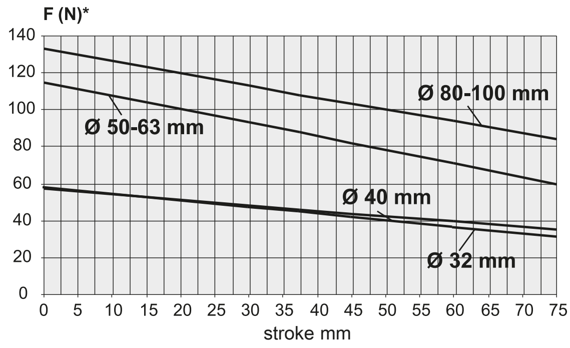
Series 31-32



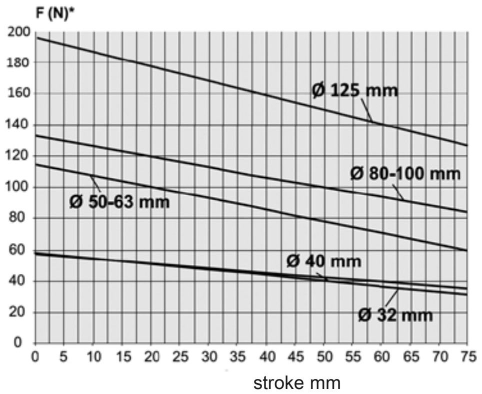
Series 31-32



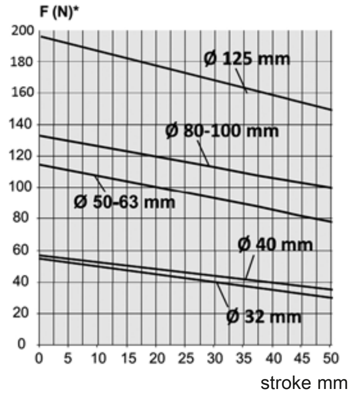
Series 60-61-42-90



Series 63 - front spring

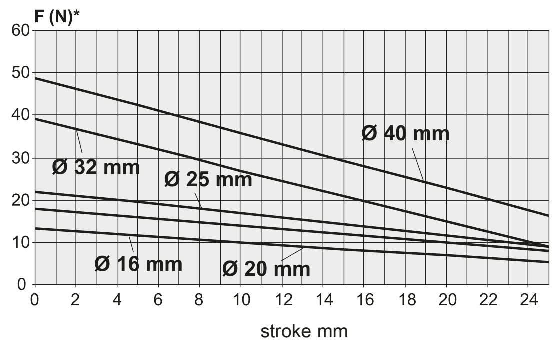


Series 63 - rear spring

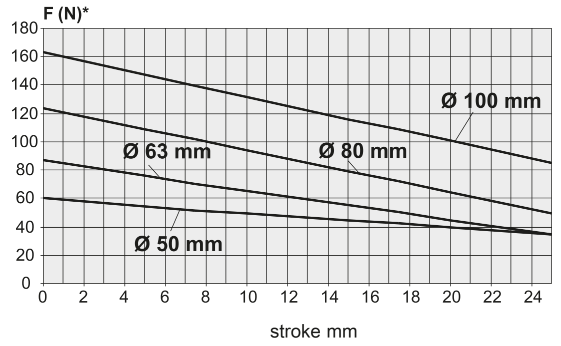


APPENDIX

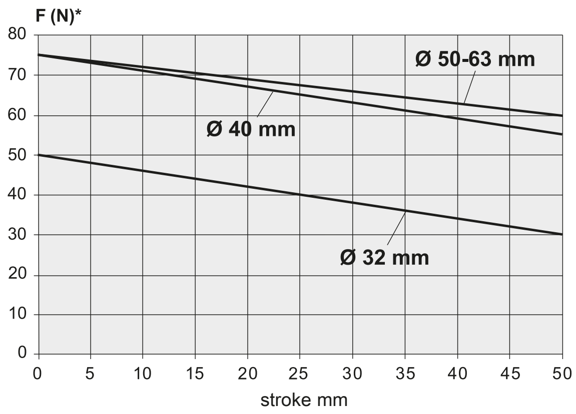
Series QP



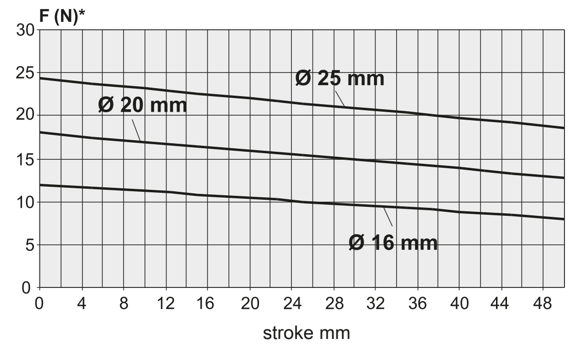
Series QP



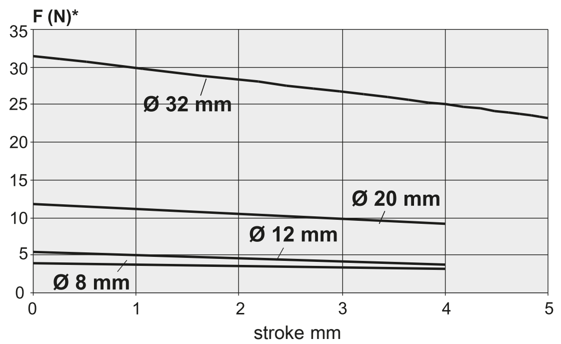
Series 90-97



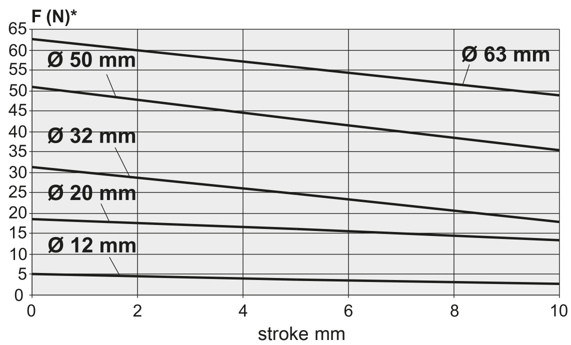
Series 94



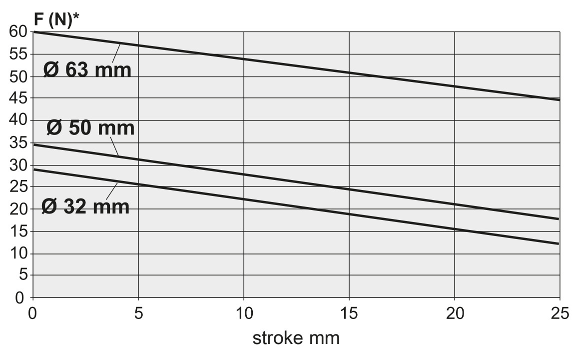
Series QN - stroke 4 and 5 mm



Series QN - stroke 10 mm



Series QN - stroke 25 mm



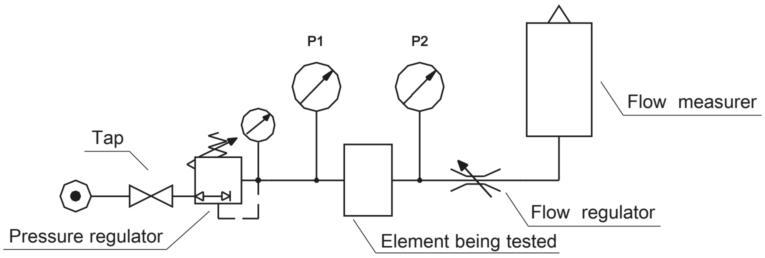
* F = spring force

Flow and speed cylinders

Valves and solenoid valves

Flow survey instruments.

The flow rate indicated in the catalogue is obtained with P1 = 6 bar and P2 = 5 bar.



Maximum speeds obtainable combining a certain flow regulator (mm/sec) with a cylinder

Mod.	Cylinders diameter (mm) 32	40	50	63	80	100	125
GSCU-1/8"; GSVU-1/8"; GMCU-1/8"; GSCU-1/8"	1000	986	629	395	246	158	100
GSCU-1/4"; GSVU-1/4"; GMCU-1/4"; GSCU-1/4"	-	1000	911	573	357	229	145
RFU 452 M5	204	-	-	-	-	-	-
RFU 482-1/8"	227	145	93	58	36	-	-
RFU 483-1/8"	520	333	212	133	83	53	-
RFU 444-1/4"	-	739	471	296	185	118	75
RFU 446-1/4"	-	-	847	532	332	213	135
SCU M5 - SVU M5	154	-	-	-	-	-	-
SCU-1/4"; SVU-1/4"; MCU-1/4"; MVU-1/4"	-	1000	660	415	259	166	105
SCU-1/8"; SVU-1/8"; MCU-1/8"; MVU-1/8"	604	387	247	155	97	62	-
SCU-3/8"; MCU-3/8"	-	-	-	622	388	249	158
SCU-1/2"; MCU-1/2"	-	-	-	-	1000	869	-

To obtain the above indicated speeds, the connected tubing should have a certain diameter and not exceed, if indicated, the max length (m)

Mod.	Tube diameter (mm) and max length (m) 4/2	6/4	8/6	10/8	12/10
GSCU-1/8"; GSVU-1/8"; GMCU-1/8"; GSCU-1/8"	-	0,4	8	25	-
GSCU-1/4"; GSVU-1/4"; GMCU-1/4"; GSCU-1/4"	-	-	4,5	18	24
RFU 452 M5	3,5	25	-	-	-
RFU 482-1/8"	3	25	-	-	-
RFU 483-1/8"	0,25	10	-	-	-
RFU 444-1/4"	-	2	17	-	-
RFU 446-1/4"	-	-	5	20	-
SCU M5 - SVU M5	5	-	-	-	-
SCU-1/4"; SVU-1/4"; MCU-1/4"; MVU-1/4"	-	0,4	8	25	-
SCU-1/8"; SVU-1/8"; MCU-1/8"; MVU-1/8"	-	7	-	-	-
SCU-3/8"; MCU-3/8"	-	-	3,5	-	-
SCU-1/2"; MCU-1/2"	-	-	-	0,25	3,5

Air flow required by the valve (6 bar) to obtain the above indicated speeds (Nl/min)

Mod.	Cylinders diameter (mm) 32	40	50	63	80	100	125
GSCU-1/8"; GSVU-1/8"; GMCU-1/8"; GSCU-1/8"	336	517	517	517	517	517	517
GSCU-1/4"; GSVU-1/4"; GMCU-1/4"; GSCU-1/4"	-	525	750	750	750	750	750
RFU 452 M5	69	-	-	-	-	-	-
RFU 482-1/8"	76	76	76	76	76	-	-
RFU 483-1/8"	175	175	175	175	175	175	-
RFU 444-1/4"	-	388	388	388	388	388	388
RFU 446-1/4"	-	-	697	697	697	697	697
SCU M5 - SVU M5	52	-	-	-	-	-	-
SCU-1/4"; SVU-1/4"; MCU-1/4"; MVU-1/4"	-	525	543	543	543	543	543
SCU-1/8"; SVU-1/8"; MCU-1/8"; MVU-1/8"	203	203	203	203	203	203	-
SCU-3/8"; MCU-3/8"	-	-	-	815	815	815	815
SCU-1/2"; MCU-1/2"	-	-	-	-	2100	2846	-

Output forces double-acting cylinders

Thrust side

Values in Newton

SERIES > 16 24 25 27 31 32 QP QN QCT QCB QCTB QCTF 40 41 42 50 52 60 61 62 63 90 92 94 95 97

Ø	Thrust side	Pressure									
		MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
8	0,50	4,44	8,9	13,3	17,7	22,2	26,6	31,0	35,5	39,9	44,4
10	0,79	6,93	13,9	20,8	27,7	34,7	41,6	48,5	55,4	62,4	69,3
12	1,13	9,98	20,0	29,9	39,9	49,9	59,9	69,9	79,8	89,8	99,8
16	2,01	17,74	35,5	53,2	71,0	88,7	106,5	124,2	141,9	159,7	177,4
20	3,14	27,72	55,4	83,2	110,9	138,6	166,3	194,1	221,8	249,5	277,2
25	4,91	43,32	86,6	130,0	173,3	216,6	259,9	303,2	346,5	389,9	433,2
32	8,04	70,97	141,9	212,9	283,9	354,9	425,8	496,8	567,8	638,7	709,7
40	12,56	110,89	221,8	332,7	443,6	554,5	665,4	776,2	887,1	998,0	1108,9
50	19,63	173,27	346,5	519,8	693,1	866,3	1039,6	1212,9	1386,2	1559,4	1732,7
63	31,16	275,08	550,2	825,2	1100,3	1375,4	1650,5	1925,6	2200,7	2475,7	2750,8
80	50,24	443,57	887,1	1330,7	1774,3	2217,8	2661,4	3105,0	3548,6	3992,1	4435,7
100	78,50	693,08	1386,2	2079,2	2772,3	3465,4	4158,5	4851,5	5544,6	6237,7	6930,8
125	122,66	1082,93	2165,9	3248,8	4331,7	5414,7	6497,6	7580,5	8663,5	9746,4	10829,3
160	200,96	1774,28	3548,6	5322,8	7097,1	8871,4	10645,7	12419,9	14194,2	15968,5	17742,8
200	314,00	2772,31	5544,6	8316,9	11089,2	13861,5	16633,8	19406,1	22178,4	24950,8	27723,1
250	490,62	4331,73	8663,5	12995,2	17326,9	21658,6	25990,4	30322,1	34653,8	38985,6	43317,3
320	803,84	7097,10	14194,2	21291,3	28388,4	35485,5	42582,6	49679,7	56776,8	63873,9	70971,0

SERIES > QX

Ø	Thrust side	Pressure									
		MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
10	1,58	14,22	28,44	42,66	56,88	71,1	85,32	99,54	113,76	127,98	142,2
16	4,02	35,48	71	106,4	142	177,4	213	248,4	283,8	319,4	354,8
20	6,28	55,44	110,8	166,4	221,8	277,2	332,6	388,2	443,6	499	554,4
25	9,82	86,64	173,2	260	346,6	433,2	519,8	606,4	693	779,8	866,4
32	16,08	141,94	283,8	425,8	567,8	709,8	851,6	993,6	1135,6	1277,4	1419,4

Traction side

Values in Newton

SERIES > 16 24 25 40 41 42 60 61 62 63 90 92 94 95 97

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm²	mm	cm²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
8	0,50	4	0,38	3,33	6,7	10,0	13,3	16,6	20,0	23,3	26,6	29,9	33,3
10	0,79	4	0,66	5,82	11,6	17,5	23,3	29,1	34,9	40,8	46,6	52,4	58,2
12	1,13	6	0,85	7,49	15,0	22,5	29,9	37,4	44,9	52,4	59,9	67,4	74,9
16	2,01	6	1,73	15,25	30,5	45,7	61,0	76,2	91,5	106,7	122,0	137,2	152,5
20	3,14	8	2,64	23,29	46,6	69,9	93,1	116,4	139,7	163,0	186,3	209,6	232,9
25	4,91	10	4,12	36,39	72,8	109,2	145,5	181,9	218,3	254,7	291,1	327,5	363,9
32	8,04	12	6,91	60,99	122,0	183,0	244,0	305,0	365,9	426,9	487,9	548,9	609,9
40	12,56	16	10,55	93,15	186,3	279,4	372,6	465,7	558,9	652,0	745,2	838,3	931,5
50	19,63	20	16,49	145,55	291,1	436,6	582,2	727,7	873,3	1018,8	1164,4	1309,9	1455,5
63	31,16	20	28,02	247,36	494,7	742,1	989,4	1236,8	1484,2	1731,5	1978,9	2226,2	2473,6
80	50,24	25	45,33	400,25	800,5	1200,8	1601,0	2001,3	2401,5	2801,8	3202,0	3602,3	4002,5
100	78,50	25	73,59	649,76	1299,5	1949,3	2599,0	3248,8	3898,6	4548,3	5198,1	5847,8	6497,6
125	122,66	32	114,62	1011,96	2023,9	3035,9	4047,8	5059,8	6071,8	7083,7	8095,7	9107,6	10119,6
160	200,96	40	188,40	1663,38	3326,8	4990,2	6653,5	8316,9	9980,3	11643,7	13307,1	14970,5	16633,8
200	314,00	40	301,44	2661,41	5322,8	7984,2	10645,7	13307,1	15968,5	18629,9	21291,3	23952,7	26614,1
250	490,62	50	471,00	4158,46	8316,9	12475,4	16633,8	20792,3	24950,8	29109,2	33267,7	37426,1	41584,6
320	803,84	63	772,68	6822,02	13644,0	20466,1	27288,1	34110,1	40932,1	47754,1	54576,2	61398,2	68220,2

SERIES > QX

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm²	mm	cm²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
10	1,58	6	1,0148	9,1332	18,2664	27,3996	36,5328	45,666	54,7992	63,9324	73,0656	82,1988	91,332
16	4,02	16	3,02	26,62	53,2	79,8	106,4	133	159,6	186,2	213	239,6	266,2
20	6,28	20	4,72	41,58	83,2	124,8	166,4	208	249,6	291	332,6	374,2	415,8
25	9,82	24	7,56	66,68	133,4	200	266,6	333,4	400	466,8	533,4	600	666,8
32	16,08	32	12,06	106,46	213	319,4	425,8	532,2	638,8	745,2	851,6	958,2	1064,6

Traction side

Values in Newton

SERIES > 31 32

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm^2	mm	cm^2	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
12	1,13	6	0,85	7,49	15,0	22,5	29,9	37,4	44,9	52,4	59,9	67,4	74,9
16	2,01	8	1,51	13,31	26,6	39,9	53,2	66,5	79,8	93,1	106,5	119,8	133,1
20	3,14	10	2,36	20,79	41,6	62,4	83,2	104,0	124,8	145,5	166,3	187,1	207,9
25	4,91	10	4,12	36,39	72,8	109,2	145,5	181,9	218,3	254,7	291,1	327,5	363,9
32	8,04	12	6,91	60,99	122,0	183,0	244,0	305,0	365,9	426,9	487,9	548,9	609,9
40	12,56	12	11,43	100,91	201,8	302,7	403,6	504,6	605,5	706,4	807,3	908,2	1009,1
50	19,63	16	17,62	155,53	311,1	466,6	622,1	777,6	933,2	1088,7	1244,2	1399,7	1555,3
63	31,16	16	29,15	257,34	514,7	772,0	1029,4	1286,7	1544,0	1801,4	2058,7	2316,1	2573,4
80	50,24	20	47,10	415,85	831,7	1247,5	1663,4	2079,2	2495,1	2910,9	3326,8	3742,6	4158,5
100	78,50	25	73,59	649,76	1299,5	1949,3	2599,0	3248,8	3898,6	4548,3	5198,1	5847,8	6497,6

SERIES > QP

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm^2	mm	cm^2	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
12	1,13	6	0,85	7,49	15,0	22,5	29,9	37,4	44,9	52,4	59,9	67,4	74,9
16	2,01	8	1,51	13,31	26,6	39,9	53,2	66,5	79,8	93,1	106,5	119,8	133,1
20	3,14	10	2,36	20,79	41,6	62,4	83,2	104,0	124,8	145,5	166,3	187,1	207,9
25	4,91	10	4,12	36,39	72,8	109,2	145,5	181,9	218,3	254,7	291,1	327,5	363,9
32	8,04	12	6,91	60,99	122,0	183,0	244,0	305,0	365,9	426,9	487,9	548,9	609,9
40	12,56	16	10,55	93,15	186,3	279,4	372,6	465,7	558,9	652,0	745,2	838,3	931,5
50	19,63	16	17,62	155,53	311,1	466,6	622,1	777,6	933,2	1088,7	1244,2	1399,7	1555,3
63	31,16	20	28,02	247,36	494,7	742,1	989,4	1236,8	1484,2	1731,5	1978,9	2226,2	2473,6
80	50,24	25	45,33	400,25	800,5	1200,8	1601,0	2001,3	2401,5	2801,8	3202,0	3602,3	4002,5
100	78,50	25	73,59	649,76	1299,5	1949,3	2599,0	3248,8	3898,6	4548,3	5198,1	5847,8	6497,6

SERIES > 27

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm^2	mm	cm^2	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
20	3,14	8	2,64	23,29	46,6	69,9	93,1	116,4	139,7	163,0	186,3	209,6	232,9
25	4,91	10	4,12	36,39	72,8	109,2	145,5	181,9	218,3	254,7	291,1	327,5	363,9
32	8,04	12	6,91	60,99	122,0	183,0	244,0	305,0	365,9	426,9	487,9	548,9	609,9
40	12,56	16	10,55	93,15	186,3	279,4	372,6	465,7	558,9	652,0	745,2	838,3	931,5
50	19,63	16	17,62	155,53	311,1	466,6	622,1	777,6	933,2	1088,7	1244,2	1399,7	1555,3
63	31,16	20	28,02	247,36	494,7	742,1	989,4	1236,8	1484,2	1731,5	1978,9	2226,2	2473,6

SERIES > QCT QCB QCTF QCBF

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm^2	mm	cm^2	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
20	3,14	10	2,36	20,79	41,6	62,4	83,2	104,0	124,8	145,5	166,3	187,1	207,9
25	4,91	12	3,78	33,34	66,7	100,0	133,3	166,7	200,0	233,4	266,7	300,0	333,4
32	8,04	16	6,03	53,23	106,5	159,7	212,9	266,1	319,4	372,6	425,8	479,1	532,3
40	12,56	16	10,55	93,15	186,3	279,4	372,6	465,7	558,9	652,0	745,2	838,3	931,5
50	19,63	20	16,49	145,55	291,1	436,6	582,2	727,7	873,3	1018,8	1164,4	1309,9	1455,5
63	31,16	20	28,02	247,36	494,7	742,1	989,4	1236,8	1484,2	1731,5	1978,9	2226,2	2473,6

Table showing air consumption of double-acting cylinders

Thrust side

Values in Nl for each 10 mm of stroke

SERIES > 16 24 25 27 31 32 QP QCT QCB QCTB QCTF 40 41 42 50 52 60 61 62 63 90 92 94 95 97

Ø	Thrust side	Pressure									
		MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	**cm²**	**0,10 (1)**	**0,20 (2)**	**0,30 (3)**	**0,40 (4)**	**0,50 (5)**	**0,60 (6)**	**0,70 (7)**	**0,80 (8)**	**0,90 (9)**	**1 (10)**
8	0,50	0,001	0,002	0,002	0,003	0,003	0,004	0,004	0,005	0,005	0,006
10	0,79	0,002	0,002	0,003	0,004	0,005	0,005	0,006	0,007	0,008	0,009
12	1,13	0,002	0,003	0,005	0,006	0,007	0,008	0,009	0,010	0,011	0,012
16	2,01	0,004	0,006	0,008	0,010	0,012	0,014	0,016	0,018	0,020	0,022
20	3,14	0,006	0,009	0,013	0,016	0,019	0,022	0,025	0,028	0,031	0,035
25	4,91	0,010	0,015	0,020	0,025	0,029	0,034	0,039	0,044	0,049	0,054
32	8,04	0,016	0,024	0,032	0,040	0,048	0,056	0,064	0,072	0,080	0,088
40	12,56	0,025	0,038	0,050	0,063	0,075	0,088	0,100	0,113	0,126	0,138
50	19,63	0,039	0,059	0,079	0,098	0,118	0,137	0,157	0,177	0,196	0,216
63	31,16	0,062	0,093	0,125	0,156	0,187	0,218	0,249	0,280	0,312	0,343
80	50,24	0,100	0,151	0,201	0,251	0,301	0,352	0,402	0,452	0,502	0,553
100	78,50	0,157	0,236	0,314	0,393	0,471	0,550	0,628	0,707	0,785	0,864
125	122,66	0,245	0,368	0,491	0,613	0,736	0,859	0,981	1,104	1,227	1,349
160	200,96	0,402	0,603	0,804	1,005	1,206	1,407	1,608	1,809	2,010	2,211
200	314,00	0,628	0,942	1,256	1,570	1,884	2,198	2,512	2,826	3,140	3,454
250	490,63	0,981	1,472	1,963	2,453	2,944	3,434	3,925	4,416	4,906	5,397
320	803,84	1,608	2,412	3,215	4,019	4,823	5,627	6,431	7,235	8,038	8,842

SERIES > QX

Ø	Thrust side	Pressure									
		MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	**cm²**	**0,10 (1)**	**0,20 (2)**	**0,30 (3)**	**0,40 (4)**	**0,50 (5)**	**0,60 (6)**	**0,70 (7)**	**0,80 (8)**	**0,90 (9)**	**1 (10)**
10	1,58	0,003	0,005	0,006	0,008	0,009	0,011	0,013	0,014	0,016	0,017
16	4,02	0,008	0,012	0,016	0,02	0,024	0,028	0,032	0,036	0,04	0,044
20	6,28	0,012	0,018	0,026	0,032	0,038	0,044	0,05	0,056	0,062	0,07
25	9,82	0,02	0,03	0,04	0,05	0,058	0,068	0,078	0,088	0,098	0,108
32	16,08	0,032	0,048	0,064	0,08	0,096	0,112	0,128	0,144	0,16	0,176

Traction side

Values in Nl for each 10 mm of stroke

SERIES > 16 24 25 40 41 42 60 61 62 63 90 92 94 95 97

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	**cm²**	**mm**	**cm²**	**0,10 (1)**	**0,20 (2)**	**0,30 (3)**	**0,40 (4)**	**0,50 (5)**	**0,60 (6)**	**0,70 (7)**	**0,80 (8)**	**0,90 (9)**	**1 (10)**
8	0,50	4	0,38	0,001	0,001	0,002	0,002	0,002	0,003	0,003	0,003	0,004	0,004
10	0,79	4	0,66	0,001	0,002	0,003	0,003	0,004	0,005	0,005	0,006	0,007	0,007
12	1,13	6	0,85	0,002	0,003	0,003	0,004	0,005	0,006	0,007	0,008	0,008	0,009
16	2,01	6	1,73	0,003	0,005	0,007	0,009	0,010	0,012	0,014	0,016	0,017	0,019
20	3,14	8	2,64	0,005	0,008	0,011	0,013	0,016	0,018	0,021	0,024	0,026	0,029
25	4,91	10	4,12	0,008	0,012	0,016	0,021	0,025	0,029	0,033	0,037	0,041	0,045
32	8,04	12	6,91	0,014	0,021	0,028	0,035	0,041	0,048	0,055	0,062	0,069	0,076
40	12,56	16	10,55	0,021	0,032	0,042	0,053	0,063	0,074	0,084	0,095	0,106	0,116
50	19,63	20	16,49	0,033	0,049	0,066	0,082	0,099	0,115	0,132	0,148	0,165	0,181
63	31,16	20	28,02	0,056	0,084	0,112	0,140	0,168	0,196	0,224	0,252	0,280	0,308
80	50,24	25	45,33	0,091	0,136	0,181	0,227	0,272	0,317	0,363	0,408	0,453	0,499
100	78,50	25	73,59	0,147	0,221	0,294	0,368	0,442	0,515	0,589	0,662	0,736	0,810
125	122,66	32	114,62	0,229	0,344	0,458	0,573	0,688	0,802	0,917	1,032	1,146	1,261
160	200,96	40	188,40	0,377	0,565	0,754	0,942	1,130	1,319	1,507	1,696	1,884	2,072
200	314,00	40	301,44	0,603	0,904	1,206	1,507	1,809	2,110	2,412	2,713	3,014	3,316
250	490,63	50	471,00	0,942	1,413	1,884	2,355	2,826	3,297	3,768	4,239	4,710	5,181
320	803,84	63	772,68	1,545	2,318	3,091	3,863	4,636	5,409	6,181	6,954	7,727	8,500

SERIES > QX

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	**cm²**	**mm**	**cm²**	**0,10 (1)**	**0,20 (2)**	**0,30 (3)**	**0,40 (4)**	**0,50 (5)**	**0,60 (6)**	**0,70 (7)**	**0,80 (8)**	**0,90 (9)**	**1 (10)**
10	1,58	6	1,0148	0,002	0,003	0,004	0,005	0,006	0,007	0,008	0,009	0,010	0,011
16	4,02	16	3,02	0,006	0,01	0,012	0,016	0,018	0,022	0,024	0,028	0,03	0,034
20	6,28	20	4,72	0,01	0,014	0,018	0,024	0,028	0,032	0,038	0,042	0,048	0,052
25	9,82	24	7,56	0,016	0,022	0,03	0,038	0,046	0,052	0,06	0,068	0,076	0,084
32	16,08	32	12,06	0,024	0,036	0,048	0,06	0,072	0,084	0,096	0,108	0,12	0,132

Traction side

Values in Nl for each 10 mm of stroke

SERIES > 31 32

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm²	mm	cm²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
12	1,13	6	0,85	0,002	0,003	0,003	0,004	0,005	0,006	0,007	0,008	0,008	0,009
16	2,01	8	1,51	0,003	0,005	0,006	0,008	0,009	0,011	0,012	0,014	0,015	0,017
20	3,14	10	2,36	0,005	0,007	0,009	0,012	0,014	0,016	0,019	0,021	0,024	0,026
25	4,91	10	4,12	0,008	0,012	0,016	0,021	0,025	0,029	0,033	0,037	0,041	0,045
32	8,04	12	6,91	0,014	0,021	0,028	0,035	0,041	0,048	0,055	0,062	0,069	0,076
40	12,56	12	11,43	0,023	0,034	0,046	0,057	0,069	0,080	0,091	0,103	0,114	0,126
50	19,63	16	17,62	0,035	0,053	0,070	0,088	0,106	0,123	0,141	0,159	0,176	0,194
63	31,16	16	29,15	0,058	0,087	0,117	0,146	0,175	0,204	0,233	0,262	0,291	0,321
80	50,24	20	47,10	0,094	0,141	0,188	0,236	0,283	0,330	0,377	0,424	0,471	0,518
100	78,50	25	73,59	0,147	0,221	0,294	0,368	0,442	0,515	0,589	0,662	0,736	0,810

SERIES > QP

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm²	mm	cm²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
12	1,13	6	0,85	0,002	0,003	0,003	0,004	0,005	0,006	0,007	0,008	0,008	0,009
16	2,01	8	1,51	0,003	0,005	0,006	0,008	0,009	0,011	0,012	0,014	0,015	0,017
20	3,14	10	2,36	0,005	0,007	0,009	0,012	0,014	0,016	0,019	0,021	0,024	0,026
25	4,91	10	4,12	0,008	0,012	0,016	0,021	0,025	0,029	0,033	0,037	0,041	0,045
32	8,04	12	6,91	0,014	0,021	0,028	0,035	0,041	0,048	0,055	0,062	0,069	0,076
40	12,56	16	10,55	0,021	0,032	0,042	0,053	0,063	0,074	0,084	0,095	0,106	0,116
50	19,63	16	17,62	0,035	0,053	0,070	0,088	0,106	0,123	0,141	0,159	0,176	0,194
63	31,16	20	28,02	0,056	0,084	0,112	0,140	0,168	0,196	0,224	0,252	0,280	0,308
80	50,24	25	45,33	0,091	0,136	0,181	0,227	0,272	0,317	0,363	0,408	0,453	0,499
100	78,50	25	73,59	0,147	0,221	0,294	0,368	0,442	0,515	0,589	0,662	0,736	0,810

SERIES > 27

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm²	mm	cm²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
20	3,14	8	2,64	0,005	0,008	0,011	0,013	0,016	0,018	0,021	0,024	0,026	0,029
25	4,91	10	4,12	0,008	0,012	0,016	0,021	0,025	0,029	0,033	0,037	0,041	0,045
32	8,04	12	6,91	0,014	0,021	0,028	0,035	0,041	0,048	0,055	0,062	0,069	0,076
40	12,56	16	10,55	0,021	0,032	0,042	0,053	0,063	0,074	0,084	0,095	0,106	0,116
50	19,63	16	17,62	0,035	0,053	0,070	0,088	0,106	0,123	0,141	0,159	0,176	0,194
63	31,16	20	28,02	0,056	0,084	0,112	0,140	0,168	0,196	0,224	0,252	0,280	0,308

SERIES > QCT QCB QCTF QCBF

Ø	Thrust side	Ø rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm²	mm	cm²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
20	3,14	10	2,36	0,005	0,007	0,009	0,012	0,014	0,016	0,019	0,021	0,024	0,026
25	4,91	12	3,78	0,008	0,011	0,015	0,019	0,023	0,026	0,030	0,034	0,038	0,042
32	8,04	16	6,03	0,012	0,018	0,024	0,030	0,036	0,042	0,048	0,054	0,060	0,066
40	12,56	16	10,55	0,021	0,032	0,042	0,053	0,063	0,074	0,084	0,095	0,106	0,116
50	19,63	20	16,49	0,033	0,049	0,066	0,082	0,099	0,115	0,132	0,148	0,165	0,181
63	31,16	20	28,02	0,056	0,084	0,112	0,140	0,168	0,196	0,224	0,252	0,280	0,308

SERIES > ARP

	Volume (l)		Pressure (opening/closing)									
			MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
Mod.	open.	/clos.	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
ARP 001	0,03	0,03	0,05/0,05	0,08/0,08	0,11/0,11	0,13/0,13	0,16/0,16	0,19/0,19	0,21/0,21	0,24/0,24	0,27/0,27	0,29/0,29
ARP 003	0,10	0,10	0,20/0,20	0,30/0,30	0,40/0,40	0,50/0,50	0,60/0,60	0,70/0,70	0,80/0,80	0,90/0,90	1,00/1,00	1,10/1,10
ARP 005	0,20	0,30	0,40/0,60	0,60/0,90	0,80/1,20	1,00/1,50	1,20/1,80	1,40/2,10	1,60/2,40	1,80/2,70	2,00/3,00	2,20/3,30
ARP 010	0,40	0,50	0,80/1,00	1,20/1,50	1,60/2,00	2,00/2,50	2,40/3,00	2,80/3,50	3,20/4,00	3,60/4,50	4,00/5,00	4,40/5,50
ARP 012	0,49	0,64	0,98/1,28	1,47/1,92	1,96/2,56	2,45/3,20	2,94/3,84	3,43/4,48	3,92/5,12	4,41/5,76	4,90/6,40	5,39/7,04
ARP 020	0,90	1,00	1,80/2,00	2,70/3,00	3,60/4,00	4,50/5,00	5,40/6,00	6,30/7,00	7,20/8,00	8,10/9,00	9,00/10,00	9,90/11,00
ARP 035	1,69	1,90	3,38/3,80	5,07/5,70	6,76/7,60	8,45/9,50	10,14/11,40	11,83/13,30	13,52/15,20	15,21/17,10	16,90/19,00	18,59/20,90
ARP 055	2,80	3,40	5,60/6,80	8,40/10,20	11,20/13,60	14,00/17,00	16,80/20,40	19,60/23,80	22,40/27,20	25,20/30,60	28,00/34,00	30,80/37,40
ARP 055	2,80	3,40	5,60/6,80	8,40/10,20	11,20/13,60	14,00/17,00	16,80/20,40	19,60/23,80	22,40/27,20	25,20/30,60	28,00/34,00	30,80/37,40
ARP 070	3,05	3,70	6,10/7,40	9,15/11,10	12,20/14,80	15,25/18,50	18,30/22,20	21,35/25,90	24,40/29,60	27,45/33,30	30,50/37,00	33,55/40,70
ARP 100	5,52	5,90	11,04/11,80	16,56/17,70	22,08/23,60	27,60/29,50	33,12/35,40	38,64/41,30	44,16/47,20	49,68/53,10	55,20/59,00	60,72/64,90
ARP 150	7,60	9,60	15,20/19,20	22,80/28,80	30,40/38,40	38,00/48,00	45,60/57,60	53,20/67,20	60,80/76,80	68,40/86,40	76,00/96,00	83,60/105,60
ARP 250	8,50	9,80	17,00/19,60	25,50/29,40	34,00/39,20	42,50/49,00	51,00/58,80	59,50/68,60	68,00/78,40	76,50/88,20	85,00/98,00	93,50/107,80
ARP 400	13,60	17,50	27,20/35,00	40,80/52,50	54,40/70,00	68,00/87,50	81,60/105,00	95,20/122,50	108,80/140,00	122,40/157,50	136,00/175,00	149,60/192,50

Dimensioning guide for Shock Absorbers Series SA

In order to select the correct dimensions of Shock absorbers the following parameters are needed:

- Weight of the impact object	m	(kg)
- Impact speed	v	(m/s)
- Propelling or thrust force	F	(N)
- No. of impact cycles per hour	C	(/hr)

Some formulas

1. Kinetic energy	$E_K = mv^2/2$
2. Drive energy	$E_D = F \cdot S$
3. Total energy	$E_T = E_K + E_D$
4. Free fall speed	$v = \sqrt{(2g*h)}$

Some formulas

5. Cylinder's traction force	$F = \frac{D^2 \cdot \pi}{4} \cdot P \cdot g/100$
6. Cylinder's thrust force	$F = \frac{(D^2 - d^2) \cdot \pi}{4} \cdot P \cdot g/100$
7. Maximum shock force (approx.)	$Fm = 1.2\ E_T / S$
8. Total energy consumption per hour	$E_{TC} = E_T \cdot C$
9. Mass	$Me = 2E_T/v^2$

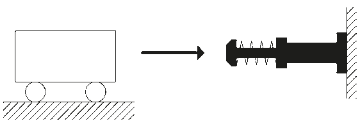
Dimensioning guide: formulas and examples

Symbols description

Symbol	Unit	Description	Symbol	Unit	Description
m		friction coefficient	Fm	(N)	maximum shock force
a	(rad)	angle of incline	g	(m/s²)	gravity acceleration (9.81 m/s²)
q	(rad)	side load angle	h	(m)	hight
w	(rad/s)	angular velocity	m	(kg)	mass to be decelerated
A	(m)	width	Me	(kg)	effective mass
B	(m)	thickness	P	(bar)	operating pressure
C	(/hr)	impact cycles per hour	R	(m)	radius
D	(cm)	cylinder diameter	Rs	(m)	shock absorber mounting distance from rotation center
d	(cm)	piston rod diameter	S	(m)	stroke (shock absorber)
E_D	(Nm)	drive energy per cycle	T	(Nm)	driving torque
E_K	(Nm)	kinetic energy per cycle	t	(s)	deceleration time
E_T	(Nm)	total energy per cycle	v	(m/s)	velocity of impact mass
E_{TC}	(Nm)	total energy per hour	vs	(m/s)	impact velocity at shock absorber
F	(N)	propelling force			

Example 1: Horizontal impact

Application data:
v = 1.0 m/s
m = 50 kg
S = 0.01 m
C = 1500 cycles/h



Calculation:

$$E_K = \frac{mv^2}{2} = \frac{50 \cdot 1^2}{2} = 25\ Nm$$

$E_T = E_k = 25$ Nm

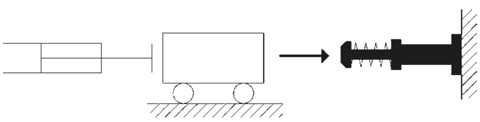
$E_{TC} = E_T \cdot C = 25 \cdot 1500 = 37500$ Nm/h

$$Me = \frac{2E_T}{v^2} = \frac{2 \cdot 25}{1^2} = 50\ kg$$

The adequate Shock Absorber to use in this case is Mod. SA 2015 according to the technical data where we find that E_T (max) = 59 Nm, E_{TC} (max) = 38000 Nm/h and Me (max) = 120 kg.

Example 2: Horizontal impact with propelling force

Application data:
m = 40 kg
P = 6 bar
S = 0.01 m first hypothesis SA 1210
v = 1.2 m/s
D = 50 mm
C = 780 cycles/h
To facilitate the calculation, the pressure in the empty cylinder chamber is not considered (safety condition)



Calculation:

$$E_K = \frac{mv^2}{2} = \frac{40 \cdot 1{,}2^2}{2} = 28{,}8\ Nm$$

Consider the shock absorber with the lowest E_T but superior to 28.8 Nm: mod. SA 2015 S=0.015 m

$$E_D = F \cdot S = \frac{D^2\ \pi}{4} \cdot P \cdot g/100 \cdot S = \frac{50^2 \cdot \pi}{4} \cdot 6 \cdot 9{,}81/100 \cdot 0{,}015 = 17{,}3\ Nm$$

$E_T = E_K + E_D = 28{,}8 + 17{,}3 = 46{,}1$ Nm

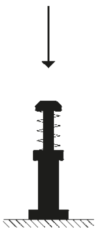
$E_{TC} = E_T \cdot C = 46{,}1 \cdot 780 = 35958$ Nm/h

$$Me = \frac{2E_T}{v^2} = \frac{2 \cdot 46{,}1}{1{,}2^2} = 64{,}0\ Kg$$

The adequate Shock Absorber to use in this case is Mod.SA 2015 according to the technical data where we find that E_T (max) = 59 Nm, E_{TC} (max) = 38000 Nm/h and Me (max) = 120 kg.

Example 3: Free fall impact

Application data:
h = 0,35 m
m = 5 kg
S = 0.01 m
first hypothesis SA 1210
C = 1500 cycles/h



Calculation:

$v = \sqrt{(2g \cdot h)}$ $\sqrt{(2 \cdot 9{,}81 \cdot 0{,}35)} = 2{,}6$ m/s

$E_K = m \cdot g \cdot h = 5 \cdot 9{,}81 \cdot 0{,}35 = 17{,}2$ Nm

Consider the shock absorber with the lowest E_T but superior to 17.2 Nm:
mod. SA 1412 S = 0.012 m

$E_D = F \cdot S = m \cdot g \cdot s = 5 \cdot 9{,}81 \cdot 0{,}012 = 0{,}6$ Nm

$E_T = E_K + E_D = 17{,}2 + 0{,}6 = 17{,}8$ Nm

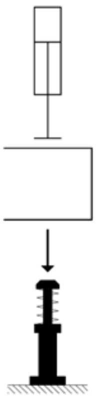
$E_{TC} = E_T \cdot C = 17{,}8 \cdot 1500 = 26700$ Nm/h

$$Me = \frac{2E_T}{v^2} = \frac{2 \cdot 17{,}5}{2{,}6^2} = 5 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 1412 according to the technical data, where we find that E_T (max) = 20 Nm, E_{TC} (max) = 33000 Nm/h and Me (max) = 40 kg.

Example 4: Vertical impact downwards with propelling force

Application data:
m = 50 kg
S = 0.025 m
P = 6 bar
D = 63 mm
C = 600 cycles/h
v = 1,0 m/s



Calculation:

$$E_K = \frac{mv^2}{2} = \frac{50 \cdot 1^2}{2} = 25 \text{ Nm}$$

$$E_D = F \cdot S = (m \cdot g + \frac{D^2 \cdot \pi}{4} \cdot P \cdot g/100) \cdot S = (50 \cdot 9{,}81 + \frac{63 \cdot \pi}{4} \cdot 6 \cdot 9{,}81/100) \cdot 0{,}025 = 58{,}1 \text{ Nm}$$

$E_T = E_K + E_D = 25 + 58{,}1 = 83{,}1$ Nm

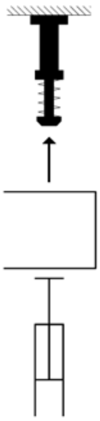
$E_{TC} = E_T \cdot C = 83{,}1 \cdot 600 = 49860$ Nm/h

$$Me = \frac{2E_T}{v^2} = \frac{2 \cdot 84}{1^2} = 168 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 2725 according to the technical data, where we find that E_T (max) = 147 Nm, E_{TC} (max) = 72000 Nm/h and Me (max) = 270 kg.

Example 5: Vertical impact upwards with propelling force

Application data:
m = 50 kg
h = 0.3 m
S = 0.025 m
first hypothesis
Mod. SA 2525
P = 6 bar =0,6 MPa
D = 63 mm
C = 600 cycles/h
v = 1,0 m/s



Calculation:

$$E_K = \frac{mv^2}{2} = \frac{50 \cdot 1^2}{2} = 25 \text{ Nm}$$

Consider the shock absorber with the lowest E_T but superior to 25 Nm:
mod. SA 2015 S=0.015 m

$$E_D = F \cdot S = (\frac{D^2 \cdot \pi}{4} \cdot P \cdot g/100 - m \cdot g) \cdot S = (\frac{63^2 \cdot \pi}{4} 6 \cdot 9{,}81/100 - 50 \cdot 9{,}81) \cdot 0{,}015 = 20{,}1 \text{ Nm}$$

$E_T = E_K + E_D = 25 + 20{,}1 = 45{,}7$ Nm

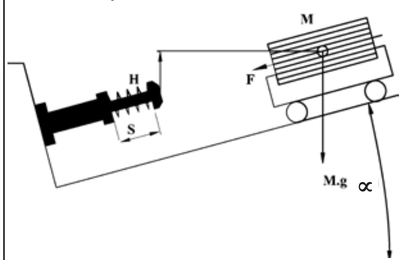
$E_{TC} = E_T \cdot C = 45{,}1 \cdot 600 = 27060$ Nm/h

$$Me = \frac{2E_T}{v^2} = \frac{2 \cdot 45{,}7}{1^2} = 91{,}4 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 2015 according to the technical data, where we find that E_T (max) = 59 Nm, E_{TC} (max) = 38000 Nm/h and Me (max)= 120 kg.

Example 6: Inclined impact

Application data:
m = 10 kg
h = 0,3 m
S = 0.015 m
∝ = 30°
C = 600 cycles/h



Calculation:

$v = \sqrt{(2g \cdot h)}$ $\sqrt{(2 \cdot 9{,}81 \cdot 0{,}3)} = 2{,}43$ m/s

$E_K = m \cdot g \cdot h$ $10 \cdot 9{,}81 \cdot 0{,}3 = 29{,}4$ Nm

$E_D = F \cdot S = m \cdot g \cdot \sin\alpha \cdot s = 10 \cdot 9{,}81 \cdot \sin 30° \cdot 0{,}015 = 10 \cdot 9{,}81 \cdot 0{,}5 \cdot 0{,}015 = 0{,}7$ Nm

$E_T = E_K + E_D = 29{,}4 + 0{,}7 = 30{,}1$ Nm

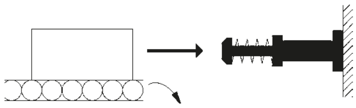
$E_{TC} = E_T \cdot C = 30{,}1 \cdot 600 = 18060$ Nm/h

$$Me = \frac{2E_T}{v^2} = \frac{2 \cdot 30{,}1}{2{,}43^{2a}} = 10{,}2 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 2015 according to the technical data, where we find that E_T (max) = 59 Nm, E_{TC} (max) = 38000 Nm/h and Me (max) = 120 kg.

Example 7: Horizontal mass on conveyer

Application data:
m = 5 kg
v = 0,5 m/s
μ = 0,25
S = 0.006 m
C = 3000 cycles/h



Calculation:

$$E_K = \frac{mv^2}{2} = \frac{5 \cdot 0{,}5^2}{2} = 0{,}63 \text{ Nm}$$

$E_D = F \,.\, S = m \cdot g \cdot \mu \cdot s = 5 \cdot 9{,}81 \cdot 0{,}25 \cdot 0{,}006 = 0{,}07$ Nm

$E_T = E_K + E_D = 0{,}63 + 0{,}07 = 0{,}7$ Nm

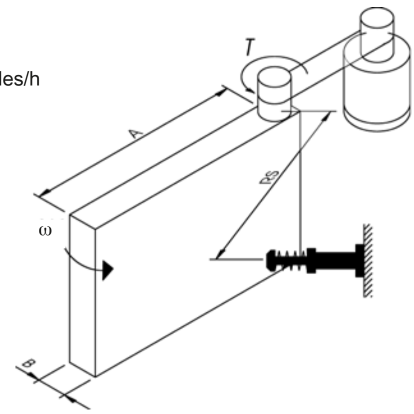
$E_{TC} = E_T \cdot C = 0{,}7 \cdot 3000 = 2100$ Nm/h

$$Me = \frac{2E_T}{v^2} = \frac{2 \cdot 07}{0{,}5^2} = 5{,}6 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 0806 according to the technical data, where we find that E_T (max) = 3 Nm, E_{TC} (max) = 7000 Nm/h and Me (max) = 6 kg.

Example 8: Horizontal rotating door

Application data:
m = 20 kg
ω = 2,0 rad/s
T = 20 Nm
Rs = 0,8 m
A = 1,0 m
S = 0,015 m
C = 600 cycles/h



Calculation:

$$I = \frac{m\,(4A^2 + B^2)}{12} = \frac{20(4 \cdot 1{,}0^2 + 0{,}05^2)}{12} = 6{,}67 \text{ Kg} \cdot \text{m}^2$$

$$E_K = \frac{I\omega^2}{2} = \frac{6{,}67 \cdot 2{,}0^2}{2} = 13{,}34 \text{ Nm}$$

$$\theta = \frac{S}{Rs} = \frac{0{,}015}{0{,}8} = 0{,}019 \text{ rad}$$

$E_D = T \cdot \theta = 20 \cdot 0{,}018 = 0{,}36$ Nm

$E_T = E_K + E_D = 13{,}34 + 0{,}36 = 13{,}7$ Nm

$E_{TC} = E_T \cdot C = 13{,}7 \cdot 600 = 8220$ Nm/h

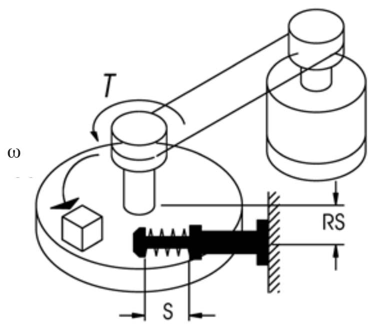
$v = \omega \cdot Rs = 2{,}0 \cdot 0{,}8 = 1{,}6$ m/s

$$Me = \frac{2\,E_T}{v^2} = \frac{2 \cdot 13{,}7}{1{,}6^2} = 10{,}7 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 1412 according to the technical data, where we find that E_T (max) = 20 Nm, E_{TC} (max) = 33000 Nm/h and Me (max) = 40 kg.

Example 9: Horizontal rotating door

Application data:
m = 200 kg
ω = 1,0 rad/s
T = 100 Nm
R = 0,5 m
Rs = 0,4 m
S = 0,015 m
C = 100 cycles/h



Calculation:

$$I = \frac{mR^2}{2} = \frac{200 \cdot 0{,}5^2}{2} = 25 \text{ Kg} \cdot \text{m}^2$$

$$E_K = \frac{I\omega^2}{2} = \frac{25 \cdot 1{,}0^2}{2} = 12{,}5 \text{ Nm}$$

$$\theta = \frac{S}{Rs} = \frac{0{,}015}{0{,}4} = 0{,}0375 \text{ rad}$$

$E_D = T \cdot \theta = 100 \cdot 0{,}0375 = 3{,}75$ Nm

$E_T = E_K + E_D = 12{,}5 + 3{,}75 = 16{,}25$ Nm

$E_{TC} = E_T \cdot C = 16{,}25 \cdot 100 = 1625$ Nm/h

$v = \omega \cdot Rs = 1{,}0 \cdot 0{,}4 = 0{,}4$ m/s

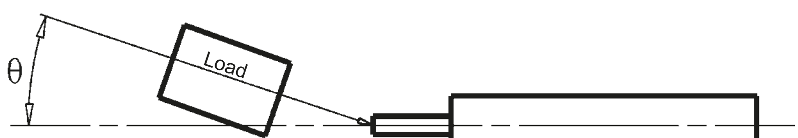
$$Me = \frac{2\,E_T}{v^2} = \frac{2 \cdot 16{,}25}{0{,}4^2} = 203 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 2015 according to the technical data, where we find that E_T (max) = 59 Nm, E_{TC} (max) = 38000 Nm/h and Me (max) = 720 kg.

Perpendicularity of the load

To ensure the lifetime of the shock absorber, the movement of the impact body must be perpendicular to the shock absorbers axial centre.

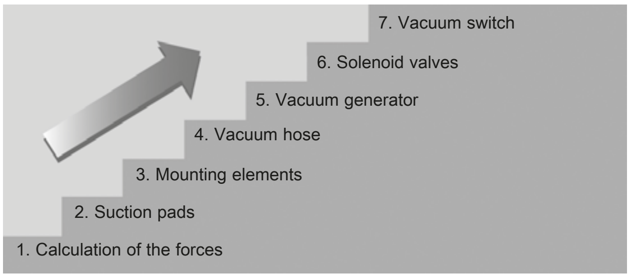
Note: The maximum allowable eccentricity $\theta \leq 2{,}5°$ (0,044 rad).



Example of Vacuum calculation

System design - the procedure

In this section the design procedure is described for a complete system step by step.
This exercise is based on a typical design example.



Flowchart for system design

The calculations in the example are based on the following data:

Workpiece		
Material:	steel sheets, stacked on a pallet	
Surface:	smooth, flat, dry	
Dimensions:	length:	max.2500 mm
	width:	max.1250 mm
	thickness:	max.2,5 mm
	weight:	circa 60 kg

Handling system		
System used:	portal transfer unit	
Available compressed air supply::		8 bar
Control voltage:	24 V DC	
Transfer procedure:	horizontal - horizontal	
Max. acceleration values	X and Y axes:	5 m/s²
	Z axis:	5 m/s²
Cycle time:	30 s	
Planned times:	for picking up:	<1s
	for releasing:	<1s

Calculating the weight of the workpiece

For all subsequent calculations, it is important to know the mass of the workpiece to be handled.
This can be calculated with the following formula:

Mass m [kg]:m = L x B x H x ρ
L = lenght [m]
B = width [m]
H = hight [m]
ρ = density [kg/m³]

Example: **m = 2,5 x 1,25 x 0,0025 x 7850**
m = 61,33 kg

Forces - how high forces do the suction pads have to support?

In order to determine the necessary holding forces, the above mass calculation is needed. In addition, the suction pads must be capable of handling the acceleration forces which, in a fully automatic system, are by no means negligible. In order to simplify the calculation, the three most important and most frequent load cases are shown graphically and described below.

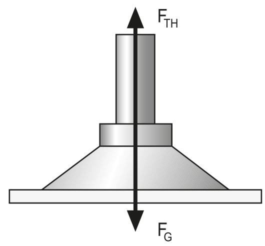
Important:
In the following simplified representations of the load cases I, II and III, the worst case with the highest theoretical holding force must always be used for the subsequent calculations.

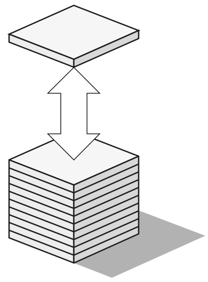
Load case I: horizontal suction pads, vertical force

F_{TH}	=	theoretical holding force [N]
m	=	mass [kg]
g	=	acceleration due to gravity [9,81 m/s²]
a	=	system acceleration [m/s²] (remember to include the "emergency off" situation!)
S	=	safety factor (minimum value 1,5; for critical inhomogeneous or porous materials or rough surfaces 2,0 or higher)

Example: F_{TH} = 61,33 x (9,81 +5) x 1,5
F_{TH} = 1363 N

The suction pads are placed on a horizontal workpiece which is to be moved sideways.





Load case II: horizontal suction pads, horizontal force

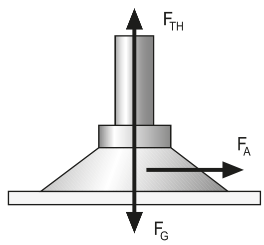
F_{TH} = m x (g +a/μ) x S

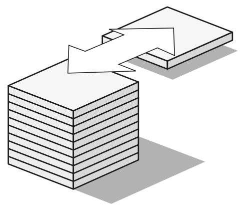
F_{TH}	=	theoretical holding force [N]
Fa	=	acceleration = m • a
m	=	mass [kg]
g	=	acceleration due to gravity [9,81 m/s²]
a	=	system acceleration [m/s²] (remember to include the "emergency off" situation!)
μ	=	coeff. of friction* = 0,1 for oily surfaces = 0,2 ...0,3 for wet surfaces = 0,5 for wood, metal, glass, stones,... = 0,6 for rough surfaces
S	=	safety factor (minimum value 1,5; for critical inhomogeneous or porous materials or rough surfaces 2,0 or higher)

Example: F_{TH} = 61,33 x (9,81 +5/0,5) x 1,5
F_{TH} = 1822 N

* Attention! The coefficients of friction shown above are average values.
The actual values for the workpiece to be handled must be determined by testing.

The suction pads are placed on a horizontal workpiece which is to be moved sideways.





Load case III: vertical suction pads, vertical force

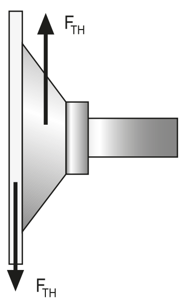
F_{TH} = (m/μ) x (g +a) x S

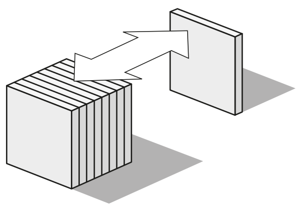
F_{TH}	=	theoretical holding force [N]
m	=	mass [kg]
g	=	acceleration due to gravity [9,81 m/s²]
a	=	system acceleration [m/s²] (remember to include the "emergency off" situation!)
μ	=	coeff. of friction = 0,1 for oily surfaces = 0,2 ...0,3 for wet surfaces = 0,5 for wood, metal, glass, stones, ... = 0,6 for rough surfaces
S	=	safety factor (minimum value 2; higher for critical, inhomogeneous or porous materials or rough surfaces)

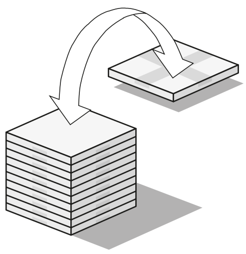
Example: F_{TH} = 61,33 x (9,81 +5/0,5) x 1,5
F_{TH} = 1822 N

For the example used for this description, load case III can be ignored, since the workpieces are to be handled only in a horizontal orientation.

The suction pads are placed on a vertical or horizontal workpiece which is to be moved vertically or turned to the other orientation.







Comparison:
A comparison of the figures for load cases I and II results, in this example, in a maximum value for FTH =1822 N in load case II, and this value is therefore used for further design calculations.

How to select the suction pads

The suction pads are normally selected on the basis of the following criteria:

Operating conditions: the operating conditions (single or multiple shift operation, expected lifetime, aggressive surroundings, temperature etc.) at the point of use are decisive for the selection of the suction pads.

For the selection of the vacuum pad material in relation to the type of work piece to handle, see the table shown in the end of the vacuum pad section.

Surface: depending on the surface of the handled workpieces, certain suction-pad versions may be more suitable.
The product range includes flat and bellows suction pads.

Example:
In this example, where steel sheets are to be handled, we will use the flat suction pads, Mod. VTCF in NBR.
This is the best and most efficient solution for the handling of smooth, flat workpieces.

Calculation of the suction force F_S [N]		
F_S	=	F_{TH} /n
F_S	=	suction force
F_{TH}	=	theoretical force
n	=	number of suction pads

Example:
For medium sized (2500 x 1250 mm) steel sheets, normally 6 to 8 suction pads would be used.
The most important criterion for deciding the number of suction pads in this example, is the flexing of the steel sheet during transport.

Calculation of the suction force F_S [N]		
F_S	=	1822/6
F_S	=	304 N

According to the Technical Data as shown on section a/3.07_01 for Series VTCF, 6 pcs. of suction pads Mod. VTCF-0950N are needed with a suction force of 340 N each.

Calculation of the suction force F_S [N]		
F_S	=	1822/8
F_S	=	228 N

According to the Technical Data as shown on section a/3.07_01 for Series VTCF, 8 pcs. of suction pads Mod. VTCF-800N are needed with a suction force of 260 N each.

In this example we decide to use 6 pcs. of suction pads Mod. VTCF-950N since this number is sufficient and helps to keep the costs down.

Important:
- The load which each suction pad can carry is shown in the table Technical Data.
- The load-carrying capacity of the suction pad must always be greater than the calculated value.

Selection of the mounting elements

Normally, the manner in which the suction pads are mounted is defined to meet the customer's needs. However, there may be special reasons which make a specific mounting element mandatory in certain cases:
Uneven or sloping surfaces
The suction pad must be able to adapt itself to the slope:
» flexible nipple NPF

Different heights or thicknesses
The suction pads must be spring-mounted in order to compensate for varying heights:
» spring plunger NPM-NPR

Example:
In this example the steel sheets are stacked on a pallet. If the sheets are larger than the pallet, they may hang down at the ends. This means that the suction pads must be able to compensate for considerable height differences and slope angles.

We decide to use:
Spring plunger NPM-FM-1/4-75
We need the largest possible stroke to cope with the hanging ends of the steel sheets.
The 1/4 thread is needed for connection to the flexible nipple.

Flexible nipple Mod. NPF
Optimum flexibility for inclined workpiece surfaces.

Check valves Mod. VNV
These are used on vacuum gripper systems containing multiple suction pads in order to shut off indivual suction pads which are not covered by the workpiece, (when handling work pieces of different sizes).

Note:
When selecting the mounting elements, please make sure that these can be screwed onto the suction pads, i.e. that they have threads of the same size. Also note the load-carrying capacities of the mounting elements.

Selection of vacuum hoses

The size of the vacuum hose should match the suction pads which are used.
For the selection of the suitable tube dimensions, see recommendations under Technical Data.

Example:
For exampe, from the table with Technical Data we choose a TRN 8/6 hose in polyammide.

Calculation vacuum generators

Based upon our experience and upon the values measured during the system design, we recommend to choose the vacuum generator depending on the diameter of the suction pad, according to the table below:

Calculation of the required suction rate V [M³/H, L/MIN]

V	=	n x VS
n	=	number of suction pads
V_s	=	required suction rate for a single suction pad [m³/h, l/min]

The suction rate values of the different vacuum generators can be found in the table Technical Data.

Example: **V = 6 x 16,6**
V = 99,6 l/min

Required suction rate as a function of the suction pad diameter

Suction pad ø	Required suction rate Vs	
up to 20 mm	0,17 m³/h	2,83 l/min
up to 40 mm	0,35 m³/h	5,83 l/min
up to 60 mm	0,5 m³/h	8,3 l/min
up to 90 mm	0,75 m³/h	12,7 l/min
up to 120 mm	1 m³/h	16,6 l/min

Note:
The indicated values apply to all types of vacuum generators.
The recommended suction rate is for a single suction pad and is valid only for smooth, air-tight surfaces. For porous surfaces we recommend the execution of a suitable test before the selection of the vacuum generator.

We choose a compact ejector Mod. VEC-20 with a suction rate of 116 l/min.

Selection of vacuum switches

Vacuum switches and pressure gauges are normally selected on the basis of the functions required in the application and on the switching frequency.

The following functions are available:
- adjustable switching point
- fixed or adjustable hysteresis
- digital and/or analog output signals
- status LED
- display with keypad
- connection with M5 Female thread, G1/8 Male flange or plug-in tube

Example:
- vacuum switch SWD-V00-PA with digital display, adjustable switching point and adjustable hysteresis (already integrated in the compact ejector)
- pressure gauge.

Selection of the vacuum switches and pressure gauges

Even if you are confident that the results of the system-design work are correct, you should still carry out tests with original workpieces to be on the safe side.
However, the theoretical system design will give you a good idea of the general parameters for the intended application.

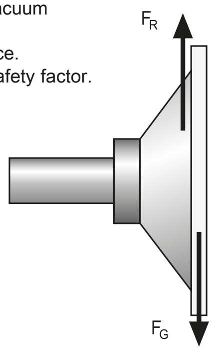
Technical information about suction pads

When designing a vacuum circuit and selecting suitable suction pads it is necessary to follow certain calculations to select each individual component in a correct way.

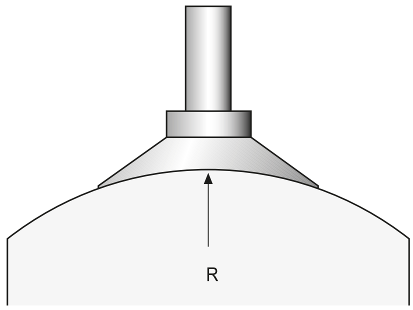
Listed below is a summary of the most common data to take into consideration.

Technical information

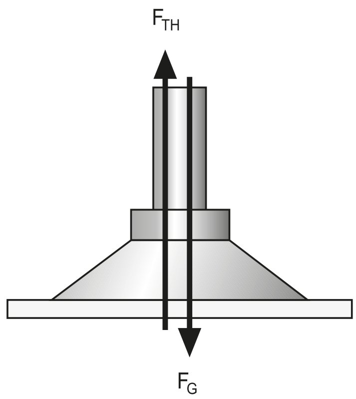
Lateral force
The measured value in N at a vacuum of -0,6 bar on a dry or oily, flat and smooth workpiece surface.
These values do not include a safety factor.



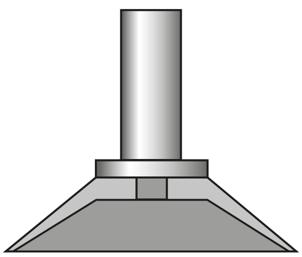
Minimum workpiece curvature radius
This specifies the minimum radius at which the workpiece can be gripped securely by the suction pad.



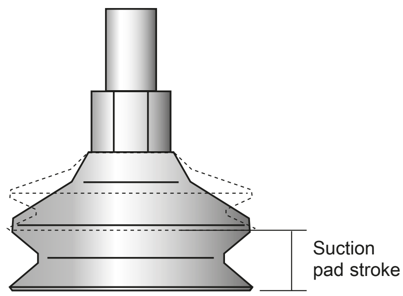
Theoretical suction force
Theoretical force (N) at a -0,6 bar measured at sea level.
Since this is a theoretical value,
it is necessary to reduce this value by adding a safety factor to compensate for friction or loss of vacuum, depending on the application (from rough workpiece surface or porous material etc.).



Internal volume
This is used to calculate the total volume of the gripper system.
With this value, it is also possible to calculate the evacuation time.



Suction pad stroke
This is the lifting effect which occurs during evacuation of a bellows type suction pad.



Suction pad material selection

Applications	NBR	SI
Food	•	
Oily parts	•	
Slight marking of workpieces		•
For high temperatures		•
For low temperatures		•
Very smooth surfaces (glass)	•	
Very rough surfaces (wood, stone)	•	•

Selection and configuration

Planning check-list for selection of suction pads	
What are the workpiece dimensions and weight?	This is important data for the suction force calculation and to establish the required suction force and number of suction pads (see technical information).
How is the workpiece surface (rough, structured, smooth)?	It determines the kind of suction pad (material, shape, dimensions).
Could the workpiece be dirty? If so, what kind of dirt?	This is important information to select the suction pad dimensioning (see technical information) and also for the design of the dust filter.
What is the highest workpiece temperature?	Temperature is important to select the suction pad material. At temperatures above 70°C the use of silicone versions should be considered.
Is an accurate gripping/placing/positionining, required?	Determines the structure, the type and the version of the suction pad.
What is the cycle time?	This data is important for the dimensioning and plays a part in the calculations (for instance the vacuum generator suction capacity calculation); (see the technical information).
What is the maximum acceleration during handling?	This is important for the dimensioning and design of the suction force, together with the related calculations (for instance the suction capacity and the moment of inertia); (see the techn. inf.).
Which kind of handling is needed (moving, slewing, turning over)?	This data is important to establish the dimension and the suction force calculation.

Materials summary

Chemical designation Abbreviation	Nitrile rubber NBR	Silicone SI
Wear resistance	••	•
Resistance to permanent deformations	••	••
General weather resistance	••	•••
Resistance to ozone	•	••••
Resistance to oil	••••	•
Resistance to fuels	••	•
Resistance to alcohol, ethanol 96 %	••••	••••
Resistance to solvents	••	••
General resistance to acids	•	•
Resistance to steam	••	••
Tensile strength	••	•
Abrasion value in mm³ s. DIN 53516 (approx.)	100-120 at 60 Sh.	180-200 at 55 Sh.
Specific resistance [ohm * cm]	-	-
Short-term temperature resistance in °C	from -30° to +120°	from -60° to +250°
Long-term temperature resistance in °C	from -10° to +70°	from -30° to +200°
Shore hardness to DIN 53505	from 40 to 90	from 30 to 85*
Colour/Coding	black	white

* After-bake of silicone 10 h/160 °C = +5 ...10 Shore A

•••• excellent   ••• very good   •• good   • poor to satisfactory