Definitions

SAFETY VALVES

Safety valve
A safety valve is a valve that automatically enables a quantity of medium to discharge without the assistance of any other energy than the medium itself, thus providing protection against a predetermined excessive pressure, and is designed in such a way that it closes again to prevent the further discharge of the medium once normal operating pressure conditions are restored.

Direct-loaded safety valve
Safety valve in which the load resulting from the medium pressure under the valve disk is only counteracted by a direct mechanical load, such as a weight, a lever with weight or a spring, for example.

Standard safety valve
A standard safety valve is a fitting which, af ter the response (beginning of lift), attains the lift required to release the mass flow within a pressure increase of max. 10 %. There are no further requirements put to the opening characteristics.

Full-lift safety valve
A full-lift safety valve is a fitting which, after the response (beginning of lift), abruptly opens to the lift stopper within a pressure increase of 5 %. The portion of the lift up to the abrupt opening (proportional range) is not to be more than 20 % of the entire lift.

Proportional safety valve
A proportional safety valve is a fitting which opens almost continuously as a function of the increase in pressure. In this respect, there is no abrupt opening without an increase in pressure over a range of more than 10 % of the lift. After the response (beginning of lift) these safety valves reach the lift required for discharging the mass flow within a maximum pressure increase of 10 %.

Diaphragm safety valve
A diaphragm safety valve is a direct-loaded safety valve in which the sliding and rotary parts as well as springs are protected against the impact of the medium by a diaphragm.

Bellows safety valve
A bellows safety valve is a direct-loaded safety valve in which sliding parts (partially or completely) as well as springs are protected against the impact of the medium by bellows. The bellows can be designed in such a way that backpressure influences are compensated to a large extent.

MISCELLANEOUS VALVES

Pressure reducer
A pressure reducer (or pressure reducing valve) is a fitting for installation in a pipe system, which makes sure that a defined outlet pressure is not exceeded at the outlet side in spite of different pressures at the inlet side (inlet pressure).

Overflow/control valve
An overflow/control valve is a valve with proportional control characteristics for pressure maintenance, pressure control and for protecting pumps or plant systems against excessive pressures.

LIFTING DEVICE

Twist-type lifting mechanism
By twisting the knurled nut anti-clockwise the valve spindle and the connected valve disc get lifted from the valve seat. The valve can be tested for correct functioning and operability.

Lifting lever
The valve gets tested by opening the valve. The valve cone gets lifted from the valve seat by pulling the lifting lever.

SEALS

Nitrile Butadiene Rubber (NBR)
Sealing material with good technological properties and a wide range of applications.

Good non-swelling properties in aliphatic hydrocarbons like propane or butan.

Ethylene-Propylene-Diene-Monomere Rubber (EPDM + EPDM Spezial)
Elastomere seals made of EPDM and peroxied cross-linked EPDM have a very good resistance against ozone, aging and wheatering. Good non-swelling properties in hot water and steam, suds and acids and chemical bases.

Fluorcarbon-polymere (FPM)
Elastomere made of FKM are highly resistant at high temperatures, have chemical stability and low permeability to gas.

Good non-swelling properties for mineral oils, greases, fuels and aromatic hydrocarbons.

Perfluorelastomeres (FFPM)
Perfluorelastomeres have the advantage of excellent chemical resitance and a large temperature range. FFKM-seals offer the highest chemical resistance of all elastomeres.

Polytetrafluorethylene (PTFE)
Non-elastic, physiologically harmless Polymere with excellent properties. Thermic application, an extremely high chemical resistanceand a repellent, non-adhesive surface.

Polytetrafluorethylen Compound (PTFE Cpd)
PTFE and TFM-PTFE can be adapted to the various applications by the help of filling materials like glass, carbon and graphite. By adding carbon, the compressive strength can be increased.

PRESSURE

Working pressure/operating pressure
The working pressure / operating pressure is the prevailing overpressure in the protected system under normal operating conditions, e.g. the required overpressure for carrying out a process step.

Response pressure
The response pressure is the set pressure at which a safety valve starts to open under operating conditions.

Set pressure
The set pressure is the overpressure at which a safety valve starts to audibly open under test bench conditions (atmospheric back-pressure).

Opening pressure/blow-off pressure
The opening pressure / blow-off pressure is the overpressure at which the safety valve reaches the lift required for discharging the mass flow; it equals the response pressure plus the opening pressure difference.

Closing pressure

The closing pressure is the static pressure on the inlet side at which the valve disk comes into contact with the seat again or at zero lift.

■ GENERAL NOTES

Information relating to the placing of an order

When ordering a safety fitting please make sure to include the following details:

- Article number
- Size of connection
- Set pressure
- Flow medium
- Temperature of medium
- Required blow-off capacity

Please observe our attached general terms of sales!

■ ATEX – EXPLOSIONS PREVENTION

European Directive 2014/34/EU for "Equipment- and Protective Systems intended for use in potentially explosive atmospheres": The directive is to be applied to products which are to be used in a potentially explosive area or in connection with a potentially explosive area.

A potentially explosive area or potentially explosive atmosphere is a combination of

I) a flammable media in the form of gasses, vapours, haze or dusts

II) and air

III) under atmospheric conditions,

IV) in which after ignition has taken place, the combustion process is transferred to the whole of the unburned mixture.

Goetze valves are in principle suitable for use in Exzones and for this purpose have been subjected to a conformity valuation process according to Directive 94/9/EC. Within the scope of these examinations an analysis of the danger as a potential source of ignition according to EN 13463-1 was carried- out with the following results:

- The valves do not have a potential source of ignition and therefore do not fall in the scope of application of ATEX.
- Provided that the individual operating conditions in the Ex-zone are taken into account, the valves may be used in specific applications.

A report and certificate from the TÜV SÜD about the special examination of our valves according to European test specifications exists.

According to the zone the equipment is to be used in, then they must be fitted with corresponding protective mechanisms.

For each category and zone within equipment group II, specially suitable safety valves, overflow valves and pressure reducing valves from our product range are available. Please contact our technical sales (see page 1.3) for applications in potentially explosive areas.

■ MARKING OF APPROVED SAFETY VALVES

All of our approved safety valves which have been tested by the TÜV Inspection Authority and in accordance with the European Pressure Equipment Directive are marked on the bonnet or on an affixed type plate with the full TÜV approval number and the CE mark including the identification number of the notified body.

TÜV SV xx-xxx xx D xx x

D or D/G or H or D/G/H or W or F or F/K/S or SOL

TÜV symbol

Safety valve

Year of the component test

Component test number

With code letters
D, D/G, D/G/H and F, F/K/S
smallest diameter d_0
in front of the valve seat in mm
with code letter H: no information
with code letterW: connection size in mm

Code letters:

G	suitable for gasses
D	suitable for steam
H	suitable for heating systems according to DIN 4751 and DIN EN 12828
D/G/H	suitable for heating systems according to DIN 4751 and DIN EN 12828
W	suitable for water heating systems according to DIN 4753
F	suitable for liquids
F/K/S	suitable for stationary pressure vessels for granular or powdery materials and for vehicle containers for liquid, granular or powdery materials
SOL	designed for the blowing-off of water and water mixtures from closed, intrinsically safe solar heating systems

coefficient of discharge α_w (K_{dr})

or discharge mass flow rate

or with code letter H and SOL: kW
with code letter W: kW (for valve sizes > DN 25)

Set pressure p in bar

CE Mark with notified body: CE 0036

DIMENSIONING OF PRESSURE REDUCING VALVES WITH K_{vs} VALUE

The application and dimensioning of pressure reducing valves in building technology is governed according to DIN EN 1567, and the correct valve size is selected using the diagrams on the corresponding data sheets for the relevant pressure reducing valve (e.g. 681 or 682).

Due to the various operational requirements in the industry, such as pressure, temperature and operating medium, the method of calculation using the valve-specific K_{vs} value according to DIN EN 60534-2-3 is common and widely used for industrial applications. The K_{vs} value enables the maximum possible flow volume for a valve to be calculated. In non-metric unit systems (SI units), the C_{vs} value is often mentioned, which is equivalent to the K_{vs} value.

In most applications, it is sufficient to perform valve dimensioning with a small amount of effort, as described in DIN EN 60534-2-3. The simplified calculation method shown in this chapter provides adequate results for this.

DEFINITION OF THE K_V VALUE (C_V VALUE)

The K_V value (C_V value) refers to a water flow volume in m3/h (U.S. gallons/min) with a temperature between 5°C and 40°C (40°F to 100°F) and with differential pressure Δp of 1 bar (1psi) between the inlet and outlet of the fitting for a determined valve position. The relationship between the K_V and C_V values is $K_V = 0.865 \bullet C_V$.

For the max. position of the valve (H=100%), the K_V value is referred to as the K_{VS} value (C_{VS} value) of the fitting.

DIMENSIONING OF THE PRESSURE REDUCING VALVE

Pressure reducing valves that are dimensioned to be too large work with a very low valve load and should thus not be overdimensioned.

Decisive factors for economical dimensioning of the pressure-reducing valve include:

- the required flow volume Q in m³/h
- the total pressure drop between the fitting inlet and the appliance as pressure loss Δp in bar
- the max. flow velocity in the following pipes in m/s

The required flow volume Q (m³/h) is available in most cases and the quantity needed at the appliance is based on the respective application.

Pressure loss Δp results, depending on the application, from the total length of the pipework, the number of pipe fittings and the nominal diameter of the pipes. When selecting the correct nominal diameter, the max. permitted flow velocity is also to be taken into account, besides the pressure loss, for reasons of noise reduction.

As the nominal diameter increases, the flow velocity in the pipe decreases. The total pressure loss Δp in the pipe thus becomes smaller.

Below is a list of the recommended maximum flow velocities in pipes, which should not be exceeded:

REFERENCE VALUES FOR FLOW VELOCITIES

	Flow velocity [m/s]
Liquids (water and similar substances)	
Suction pipes from pumps	0.5...1.0
Pressure pipes from pumps	1.5...3.0
Water mains	1.0...2.0
Cooling water pressure pipes	1.0...3.0
Cooling water suction pipes	0.5...1.0
Other liquids	
Highly viscose liquids	1
Oil pipelines	1.5…2
Thin hydraulic oil	3.5
Pipelines for gases	
Compressed air lines (depending on length)	15...25
Technical gases over 4 bar	15…40
Vapour lines	
Flash steam in condensate lines	15 ... 25
Saturated steam lines	
up to 1 bar (a)	< 10 m/s
1 to 2 bar (a)	10…15 m/s
2 to 5 bar (a)	15…25 m/s
5 to 10 bar (a)	25…35 m/s
10 to 40 bar (a)	35…40 m/s
40 bar(a)	< 60 m/s

CONTINUATION: ■ DIMENSIONING OF THE PRESSURE REDUCING VALVE

In order to have sufficient reserves in the end area of the pressure reducing valve, the K_v value determined for the pressure reducing valve from the calculation described below is to be multiplied by a dimensioning factor (DF) of 1.3. The next largest K_{VS} value for the desired pressure reducing valve is then chosen from the table on the data sheet. This ensures secure functioning in the range of around 10 - 80% of the control range.

The operating and setting pressures stated in the following examples are stated as overpressure, as is common. However, the calculations are made with absolute pressures. For instance, an absolute pressure of 6 + 1, i.e. 7 bar(a), is calculated with a setting pressure of 6 bar overpressure. What's more, it should be noted that the dimensioning should be performed with the greatest flow rate and the smallest pressure difference.

■ CALCULATION FOR LIQUIDS

Example 1:
A pressure reducing valve is being sought for water with a temperature of 60°C. It should ensure a flow volume of 28 m³/h with upstream pressure of p_1 = 8bar overpressure and downstream pressure in the range of p_2 = 4-6 bar overpressure.

The following is given:

The necessary flow volume:	$Q = 28\ m^3/h$
The pressure in front of the valve:	$p_1 = 9$ bar (a)
Selected setting pressure:	$p_2 = 7$ bar (a)
The minimum pressure drop:	$p_1 - p_2 = \Delta p = (9 - 7)$ bar $= 2$ bar
The density of water at 60°C:	$\rho = 983{,}2\ kg/m^3$

For liquids (incompressible fluids), the following applies: $K_v = Q\sqrt{\dfrac{\rho}{1000 \times \Delta p}}$

and in the example: $K_v = 28\sqrt{\dfrac{983{,}2}{1000 \times 2}} = 19.63\,\dfrac{m^3}{h}$

Multiplied by DF=1.3 makes: 19.63 m³/h x 1.3 = 25.5 m³/h

The type 682 pressure reducing valve made from red brass in the nominal diameter DN 80 with a K_{VS} value of 26 m³/h is chosen.

To check the suitable pipe nominal diameter after the pressure reducing valve, the following applies:

$$w = 353\,\frac{Q}{d^2} = 353\,\frac{28}{80^2} = 1{,}54\,\frac{m}{s}$$

w = flow velocity in m/s

d = nominal diameter of the pipeline in mm

The nominal diameter after the pressure reducing valve is correctly selected in DN 80.

■ CALCULATION FOR GASES

When calculating for gases, it is to be verified beforehand whether the flow is in the subcritical or overcritical range. To make a distinction, $p_2 = p_1/2 = \Delta p$ can be used for a rough calculation.

1. For subcritical flows, i.e. if $\Delta p < \frac{p_1}{2}$ the following applies:

$$K_v = \frac{Q_N}{519} \sqrt{\frac{\rho_N \times (t_1 + 273)}{\Delta p \times p_2}}$$

2. For overcritical flows, i.e. if $\Delta p > \frac{p_1}{2}$ the following applies:

$$K_v = \frac{Q_N}{259.5 \times p_1} \sqrt{\rho_N \times (t_1 + 273)}$$

Example 2:
A pressure reducing valve is being sought for a nitrogen line. The consumer requires 500 to 3000 Nm³/h gas at a temperature of 20°C for operations. Upstream pressure is p_1 = 40-45 bar (overpressure) from the gas supply. The minimum application pressure at the appliance is 10 bar (overpressure). However, the max. permitted downstream pressure is usually p_2 = 15 bar.

The following is given:

The necessary max. flow volume:	Q_N	= 3000 Nm³/h (under normal conditions)
Lowest pressure in front of the valve:	p_1	= 41 bar (a)
Selected setting pressure:	p_2	= 16 bar (a)
The minimum pressure drop:	p_1-p_2	= Δp = (41 – 16) bar = 25 bar
Nitrogen temperature in operation:	t_1	= 20°C
Nitrogen standard density:	ρ_n	= 1.25 kg/m³

As Δp = (41 – 16) bar = 25 bar > $p_1/2$ overcritical flow is used for calculations:

$$K_v = \frac{3000}{259.5 \times 41} \sqrt{1.25 \times (20 + 273)} = 5.4 \text{ m}^3/\text{h}$$

Multiplied by DF makes: 5.4 m³/h x 1.3 = 7.02 m³/h

The type 684 pressure reducing valve made from red brass in the nominal diameter DN 40 with a K_{VS} value of 9.4m³/h is chosen.

To check the suitable pipe nominal diameter after the pressure reducing valve, the flow volume has to be converted to operating conditions:

$$Q = Q_N \bullet \frac{1}{p} \bullet \frac{T}{273} \frac{m^3}{h}$$

Q = flow volume in an operational condition in m³/h
p = absolute operating pressure in the pipe in bar (a)
T = absolute temperature of the medium in K

The operating flow volume Q is thus:

$$Q = \frac{3000}{16} \bullet \frac{(20 + 273)}{273} = 201.2 \frac{m^3}{h}$$

To check the suitable pipe nominal diameter after the pressure reducing valve, the identical relationship as for liquids can be used:

$$w = 353 \frac{Q}{d^2} = 353 \frac{201.2}{40^2} = 44.4 \frac{m}{s}$$

The pipe nominal diameter after the pressure reducing valve is already very close to the limit in DN40. Expanding the nominal diameter to at least DN50 (w =28.4 m/s) is thus recommended.

■ OPTION S62

Inductive sensor for open/closed indication on safety valves
Goetze selects specific sensors for indicating the open/closed position on safety valves.

The inductive sensor monitors the position of the valve spindle and is installed in the upper cap/ housing of a safety valve. Depending on the design, the sensor can be attached either on the side or vertically from above on the safety valve (see Fig. 1 and 2).

Fig. 1: Sensor latterally

Fig. 2: Sensor on top

■ TECHNICAL DATA FOR INDUCTIVE SENSOR

Goetze standard sensors	L-2752	L-2753	L-2649
Manufacturer code	IEC200	IFC275	IF503A
Size of sensor	M8	M12	M12
Pressure rating	100bar	100bar	100bar
Active sensor surface material	1.4404 (316L)	1.4404 (316L)	1.4404 (316L)
Output function	normally open	normally open	normally open
Operating voltage	10 – 36 Volt (DC)	10 – 30 Volt (DC)	10 – 36Volt (DC)
Current consumption	<20mA	<10mA	<20mA
Electrical design	PNP	PNP	PNP
Protection	IP69K	IP69K	IP69K
Ambient temperature	-25 – 70°C	-40 – 85°C	-40 – 60°C
ATEX	- /-	- /-	Ex II 3G Ex nA IIC T6 Gc X
Display switching status	4x90° LED	4x90° LED	4x90° LED
Connection cable, 5m	L-2626	L-2626	L-2689
Manufacturer code	EVT004	EVT004	EVC05A
ATEX	- /-	- /-	Ex II 3G Ex nA IIC Gc
Temperature range	-25 – 100°C	-25 – 100°C	-20 – 60°C

Further functions and limit switch systems available on request

Scope of delivery:

- The sensor is installed on the safety valve and set to the maximum stroke of the valve
- An electric function test is performed on the installed sensor before final assembly
- Connection cable with connector, 5 m cable length, and terminal assignment plan (for ATEX sensor with suitable ATEX cable)

The sensors stated above are selected by the manufacturer according to valve type and nominal diameter. When ordering, please only state option S62 and the addendum ATEX, if required.

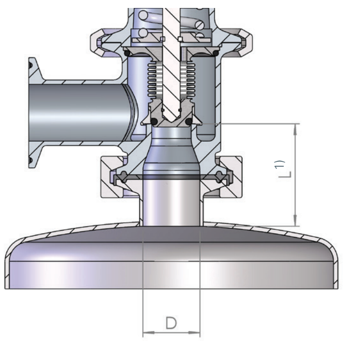
The above data is based on the technical specifications of the manufacturer, ifm electronic gmbh. If in doubt, the manufacturer's technical data sheets are binding and must be checked in detail. The data sheets will be forwarded on request.

→ General information about the hygienic valves

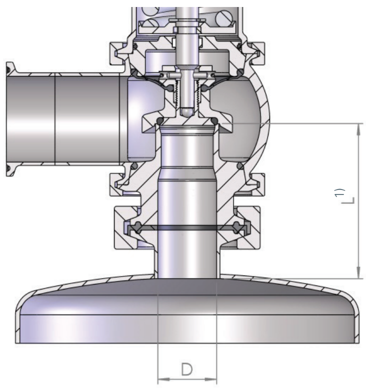
■ DEAD SPACE RATIO

The dead space ratio is determined by the ratio of the total inlet length L (usually the base of the container lid to the top of the seat) to the diameter of the inlet pipe at the widest point D. A large dead space ratio generally leads to poorer cleanability of the area under consideration. Therefore, the smaller the dead space ratio, the better the cleanability of this area.

Below you will find a schematic diagram of the dead space ratio. The information on the actual dead space ratio L/D is given in the corresponding data sheet or in a separate dimensional drawing (for special connections).



Type 400



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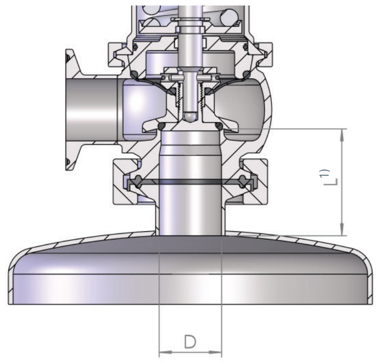

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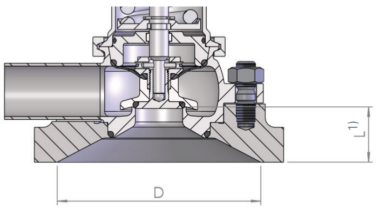

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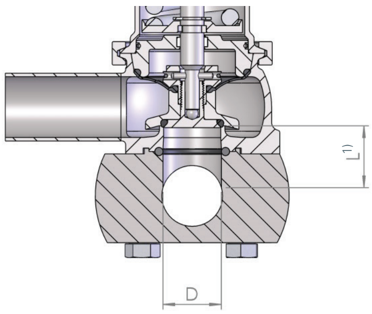
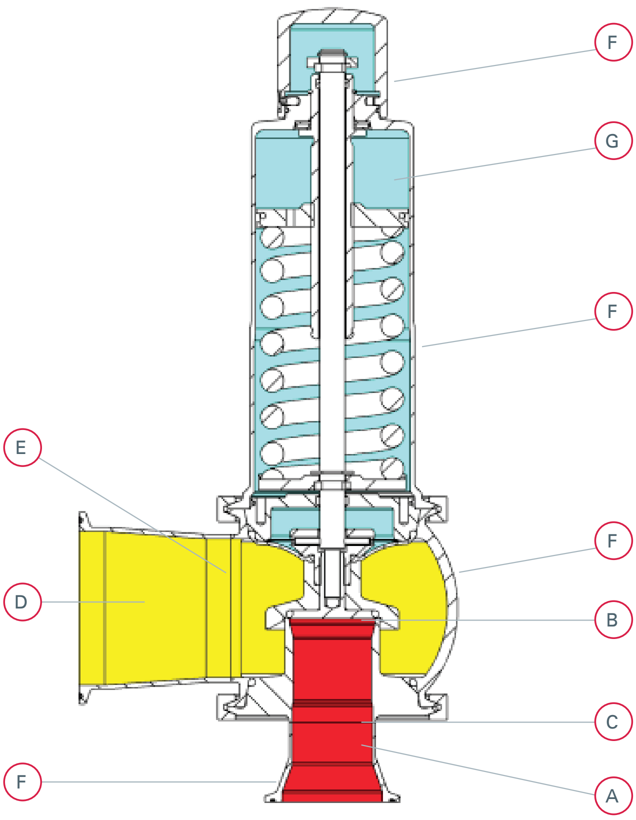


Type 4060

[1)] Actual dimension L depends on the connection piece on the container side.

■ SURFACE QUALITY FOR HYGIENIC SAFETY VALVES ACCORDING TO GOETZE STANDARD

Surface position	Comment	Surface definition according to Goetze standard
Primary surface in contact with medium (A): Valve inlet area (B): Valve disc lower surface (C): Weld seam (if present)	Primary area in permanent contact with medium	If necessary, increased surface quality as an additional option. The weld seam is ground internally in the inlet area as standard.
Secondary surface in contact with medium (D): inner surface blow-out area (E): Weld seam	Surface is not in contact with medium when the valve is closed, the surface should be suitable to ensure efficient cleaning (CIP and COP).	Taken into account seam is not ground as standard and is therefore not considered in the surface quality.
Outer surface (F): Outer surface of body, housing, cap that is not in contact with the medium	The surface is not in contact with the medium and is therefore not relevant for CIP/COP cleaning. A clean, smooth surface is nevertheless required.	No technical requirements for the surface quality. Taken into account seam is not ground as standard and is therefore not included in the surface quality. If necessary, increased surface quality, as an additional option. Add-on components such as valve clamps or lifting levers are not included.
Area not in contact with medium (G): area above the spindle seal which is shielded from the medium	For valve versions with diaphragm or bellows, this area is permanently separated from the medium.	No surface quality requirements, as not in contact with the medium.



OVERVIEW OF SURFACES AND ORDER CODES FOR THE HYGIENE VALVES

Series and series-specific option	Primary surface in contact with medium A, B, C Ra max. (µm)	Secondary surface in contact with medium D, E Ra max. (µm)	Surface weld seams D, E, F Ra max. (µm) ((1) untreated) ((2) electropolished)	Outer surface F Ra max. (µm)	mechanically polished (mechanically machined or polished)	Electropolished	Comparison primary surface in contact with medium A, B, C	
							DIN 11866, Table 3 Hygienic class	ASME BPE
400 standard	0,75	1,5	(1)	1,5	A, B, C, D, F	-	H3	SF3
400 option P05	0,375	1,5	(1)	1,5	A, B, C, D, F	-	H4	SF1
400 option P07	0,375	0,75	(2)	0,75	A, B, C, D, E, F	A, C, D, E, F	HE4	SF6
400 option P09	0,375	0,75	0,75	0,75	A, B, C, D, E, F	A, C, D, E, F	HE4	SF4
4000 standard	0,75	1,5	(1)	1,5	A, B, C, D, F	-	H3	SF3
4000 option P05	0,375	1,5	(1)	1,5	A, B, C, D, F	-	H4	SF1
4000 option P07	0,375	0,75	(2)	0,75	A, B, C, D, E, F	A, B, C, D, E, F	HE4	SF6
4000 option P09	0,375	0,75	0,75	0,75	A, B, C, D, E, F	A, B, C, D, E, F	HE4	SF4
4020 standard	0,75	1,5	(1)	1,5	A, B, C, D, F	-	H3	SF3
4020 option P05	0,375	1,5	(1)	1,5	A, B, C, D, F	-	H4	SF1
4020 option P07	0,375	0,75	(2)	0,75	A, B, C, D, E, F	A, B, C, D, E, F	HE4	SF6
4020 option P09	0,375	0,75	0,75	0,75	A, B, C, D, E, F	A, B, C, D, E, F	HE4	SF4
4040 standard	0,75	0,75	(1)	1,5	A, B, C, D, F	-	H3	SF3
4040 option P05	0,375	0,75	(1)	1,5	A, B, C, D, F	-	H4	SF1
4040 option P07	0,375	0,625	(2)	0,75	A, B, C, D, E, F	A, B, C, D, E, F	HE4	SF5
4040 option P09	0,375	0,5	0,75	0,75	A, B, C, D, E, F	A, B, C, D, E, F	HE4	SF4
4040 flange standard	0,75	-	-	1,5	A, F	No, electropolished before welding is not advisable	H3	SF3
4040 flange option P05	0,375	-	-	0,75	A, F		H4	SF1
4060 standard	0,75	0,75	(1)	1,5	A, B, C, D, F	-	H3	SF3
4060 option P05	0,375	0,75	(1)	1,5	A, B, C, D, F	-	H4	SF1
4060 option P07	0,375	0,625	(2)	0,75	A, B, C, D, E, F	A, B, C, D, E, F	HE4	SF5
4060 option P09	0,375	0,5	0,75	0,75	A, B, C, D, E, F	A, B, C, D, E, F	HE4	SF4
4060 Pipe plug standard	0,75	-	-	1,5	A, F	No, electropolished before welding is not advisable	H3	SF3
4060 Pipe plug option P05	0,375	-	-	0,75	A, F		H4	SF1

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