

- System Specification - for PVC-U Metric Piping Systems

1. Scope

This specification covers requirements for the Georg Fischer **PVC-U** Piping System intended for a wide range of applications including water, wastewater and effluent treatment as well as a wide range of chemical applications. The components of the **PVC-U** piping systems are in accordance with the following standards.

2. Basic System Data

2.1 Material Specification for Unplasticised Polyvinylchloride (PVC-U)

PVC-U pipes, fittings and valves from Georg Fischer Piping Systems shall be manufactured from unplasticised polyvinylchloride, of which pipes and fittings are designed for 25 years of operation with water as medium (20°C). **PVC-U** has also an optimal chemical resistance against many mineral acids, bases and salt solutions. For detailed information, please refer to the list of chemical resistance provided by Georg Fischer Piping Systems. The raw material used shall be material designed for use with pressure bearing piping systems with long term hydrostatic properties in accordance with EN ISO 15493, as supplied by Georg Fischer Piping Systems.

2.2 Characteristics of PVC-U Material

Characteristic	Value	Test Standards
Density	1.38 g/cm ³	ISO 1183-1
Tensile E-modules	>2400 N/mm ²	EN ISO 527-1
Charpy notched impact strength at 23 °C	6 kJ/m ²	EN ISO 179/1eA
Charpy notched impact strength at 0°C	3 kJ/m ²	EN ISO 179/1eA
Vicat heat distortion temp. B/50N	≥76 °C	ISO 306
Chemical resistance	DIBT agreement	based on the medium list 40.1.4
Thermal expansion coefficient	0.07 - 0.08 mm/mK	DIN 53752
Temperature range in °C	0°C - 60°C	
Colour	dark grey; 7011 -RAL	

2.3 PVC-U Product Range

Products	DN bar	DN																										
		6	8	10	12	16	20	25	32	40	50	63	75	90	110	100	125	150	180	200	225	250	280	315	350	400		
Pipes	16	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	10																											
	6																											
Fittings	16	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	10																											
	6																											
Ball Valve*	10				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	16			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Butterfly Valve*	10																											
Cone Check Valve*	6																											
	16																											
Diaphragm Valve*	10																											
Pressure Regulating Valve*	10																											
Flange*	16																											
	10																											
Gaskets & Pipe Clips	16	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Sensors & Controllers	--	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

* For detailed information please consult the GF Piping Systems online catalogue

For more detailed physical properties and product pressure – temperature curves, please consult the Georg Fischer Piping Systems Planning Fundamentals on the Georg Fischer Piping Systems website.

2.4 Approvals / Acceptance / Conformance

This material specification for **PVC-U** is met by Georg Fischer Piping Systems. Therefore Georg Fischer Piping Systems is approved according to different categories all over the world. For more information please consult our approvals database on the Georg Fischer Piping Systems website.

Approvals	DVGW	DIBT	GOST-R	DGS (ACS)	KIWA	CSTB	IIP	ABS	BV	CCS	DNV	GL	LR	RINA	RMROS	
	ship building															
Raw Material																
Pipes																
Fittings																
Valves*																
Flanges																
Gaskets																

* For details on which valve (ball, butterfly, diaphragm etc. ...) please contact GF database

3. Pipes

Pipes are made of **PVC-U** and processed according to the quality specifications and dimensions according to EN ISO 15493. Pipe formulation has been designed for an enhanced chemical resistance (content of CaCO₃ < 3%), enhanced thermo stabilizer package etc.

Processed pipes are straight and show a very low out-of-roundness. The wall structure is homogeneous and even.

OD-tolerances surpass the requirements of ISO 15493 and are compatible with the fitting programme of Georg Fischer Piping Systems for easy pre-assembly and minimized gaps.

For highly demanding applications in the chemical industry, the application of pressure rating SDR 9 pipes and PN 16 fittings is strongly recommended for OD ≤110 mm.

Any installation should follow the Georg Fischer Piping Systems installation guidelines for industrial piping and the guidelines issued by the DVS.

Approved pipes comply with the corresponding quality specifications of DIN Certco ZP 1.1.1.

4. Fittings

All **PVC-U** fittings shall be metric sizes manufactured by Georg Fischer Piping Systems, and shall be of a type suitable for solvent cementing, with dimensions and tolerances in accordance with EN 1452-1 & 3 and EN ISO 15493. All the requirements of those standards must be fulfilled. All threaded connections shall have pipe threads in accordance with the requirements of ISO 7-1.

4.1 PRO-FIT Fittings in PVC-U

All PRO-FIT fittings (elbows 45 ° and 90 °, tee equal, reducing bushes, and unions) shall be metric sizes from d 20-63 mm in **PVC-U** as manufactured by Georg Fischer Piping Systems. The PRO-FIT fittings shall have a 45° marking as well as integrated marking for vertical mounting and a spigot-socket design, reducing bushes shall offer the possibility of a spigot and cemented socket connection on each side of the fitting as manufactured by Georg Fischer Piping Systems.

4.2 Packaging and Labelling

The packaging must ensure that the fittings are not damaged during transportation. Packaging and labelling must meet the following requirements:

- Identification of the content, in type, quantity and product details
- Information about standards and approvals covered by the product
- Content of the label has to accomplish legal requirements
- Labels must be EAN coded for automatic identification
- Comply to Georg Fischer Piping Systems standards as well as to international standards such as ISPM15

5. Accessories

5.1 Flanges

Backing flanges in metric sizes DN15-400 shall be designed according to EN ISO 15493, in a thermo plastic-oriented design, consisting of 100% glass fibre reinforced polypropylene, PP-GF30, graphite black and UV stabilized. These flanges are manufactured in a seamless technology injection moulding process by Georg Fischer Piping Systems. The backing flange shall be optimised with a V-groove in the inner diameter to ensure an evenly distributed force on the thermo plastic flange adapter. The backing flanges shall be marked with dimension, PN-value, standards, brand and lot number. Connecting dimensions metric according to ISO 7005, EN 1092; Bolt circle diameter PN 10; Inch: ANSI B 16.5, BS 1560; class 150.

Alternatively backing flanges in metric sizes DN15-400 shall be designed according to EN ISO 15493, consisting of unplasticised polyvinyl chloride (PVC-U), in a thermo plastic-oriented design. The backing flanges shall be marked with dimension, PN-value, standards, brand and lot number. Connecting dimensions metric according to ISO 7005, EN 1092; Bolt circle diameter PN 10; Inch: ANSI B 16.5, BS 1560; class 150.

5.2 Gaskets

Gaskets in metric sizes DN10-300 shall consist of elastomeric material according to EN681, designed with or without metal reinforcement for use with solvent cementable flange adaptors according to EN ISO 15493. Gaskets with reinforcement shall be designed to be centred by the outer diameter and shall provide fixation aids to fit on the flange bolts.

5.3 Pipe Support System

Pipe Support System shall be KLIP-IT, sizes d10-400, supplied by Georg Fischer Piping Systems. The product range includes two different types of pipe clamps, type 060 and type 061. Type 60 is available for d90-400 and shall be made of PP. Type 061 is available for d10-160 and shall be made of PP or PE. Pipe clamps bigger than d40 shall be equipped with a security bow to secure the pipe.

6. Valves

All **PVC-U** valves shall be metric sizes manufactured by Georg Fischer Piping Systems or equal in accordance with EN ISO 16135, 16136 (butterfly valves), 16137 (check valves), 16138 (diaphragm valves), tested according to the same standard.

6.1 Ball Valves

All **PVC-U** ball valves, with metric sizes DN10-100, shall be Georg Fischer Piping Systems Type 546 with true double union design, manufactured by Georg Fischer Piping Systems in accordance with EN ISO 16135. Incorporated into its design shall be a safety stem with a predetermined breaking point above the upper O-ring, preventing any media leaking in the event of damage. The valve nut threads shall be buttress type to allow fast and safe radial mounting and dismounting of the valve during installation or maintenance work. Seats shall be PTFE with backing rings creating self-adjusting seals and constant operating torque. Backing rings and seals shall be EPDM or FPM. The handle shall include in its design an integrated tool for removal of the union bush. Union bushes shall have left-hand threads to prevent possible unscrewing when threaded end connectors are removed from pipe.

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Following accessories shall be available:

- A Multi-Functional Model (MFM) in PPGF equipped with internal limit switches for reliable electrical position feedback, is mounted directly between the valve body and the valve handle. This MFM is also the necessary interface for later mounting of actuators.
- Mounting plate in PPGF with integrated inserts for later screw mounting on any support
- Lockable multi-functional handle

6.1.1 Electric Ball Valves

Electric actuators shall be Types EA11 (metric sizes DN10-50), EA21 (metric sizes DN10-50), EA31 (metric sizes DN65-100) shall be available manufactured by Georg Fischer Piping Systems in accordance with EN 61010-1, EC directives 2004/108/EC (EMC) and 2006/95/EC (LVD). Additionally they need to be CE marked. Actuator housing shall be made of PPGF (polypropylene glass fibre reinforced), flame retardant with external stainless steel screws. All electric actuators shall have an integrated emergency manual override and integrated optical position indication.

All electric actuator types (with the exception of EA11) shall have the following accessories available:

- Fail-safe unit
- Heating element
- Cycle extension, cycle time monitoring, and cycle counting
- Motor current monitoring
- Position signalisation
- Positioner Type PE25
- Limit switch kits AgNi, Au, NPN, PNP, NAMUR
- AS Interface Plug Module

Electric actuator specifications of the actuators shall be as follows:

Specification	EA11	EA21	EA31	EA42
Nominal torque (Nm)	10	10	60	100
Control time (s/90°)*	5	5	15	25
Cycles at 20°C *	150,000	250,000	100,000	75,000
Duty cycles ED at 20°C	40%	100%	50%	35%
Protection class	IP65 per EN 60529 - IP67 (for vertical cable mounting and wall feed through).			
Voltage	100-230, 50-60 Hz or 24V=/24V, 50/60 Hz versions			

* at nominal torque

6.1.2 Pneumatic Ball Valves

6.1.2.1 Pneumatic Ball Valves DN15 to DN50

Pneumatic actuators shall be Georg Fischer Piping Systems Types PA11 (metric sizes DN15-25) and PA21 (metric sizes DN32-50). Pneumatic actuators shall be available as fail safe close, fail safe open and double acting and have an integrated optical position indication. Actuator housing shall be made of Polypropylene fibre glass reinforced (PPGF) and flame retardant. Actuators shall contain a preloaded spring assembly to ensure safe actuator operation and maintenance. Actuators shall contain integrated Namur interface for the easy mounting of positioners, limit switches and accessories. The valve shall be equipped with a Multi-functional-module for reliable electric feedback, mounted directly between the valve body and the actuator as manufactured by Georg Fischer Piping Systems.

6.1.2.2 Pneumatic Ball Valves DN65 to DN100

- For valve size DN65 pneumatic actuators shall be Type PA 30 (fail safe to close or open function), Type PA35 (double acting function).
- For valve size DN80 pneumatic actuators shall be Type PA 40 (fail safe to close or open function), Type PA40 (double acting function).
- For valve size DN100 pneumatic actuators shall be Type PA 45 (fail safe to close or open function), Type PA45 (double acting function)

Pneumatic actuators shall have an integrated optical position indicator. Actuator housing shall be made of hardened anodized aluminium. Actuators shall contain integrated Namur interface for the easy mounting of positioners, limit switches and accessories.

All pneumatically actuated ball valves shall have the following accessories available:

- Pilot valve remote or direct mounted in voltages 24VDC/AC, 110VAC, 230VAC
- Positioner Type DSR 500-3
- Limit switch kits Ag-Ni, Au, NPN, PNP
- Stroke limiter
- Manual override for all sizes up to DN100
- AS Interface control module with incorporated position feedback and a solenoid pilot valve

- System Specification -

6.2 Diaphragm Valves

6.2.1 Manual Diaphragm Valves

6.2.1.1 Manual Diaphragm Valves DN15 to DN50

All **PVC-U** diaphragm valves, with metric sizes DN15-50, shall be either:

- Type 514 (true double union design, DN15-50)
- Type 515 (spigot design, DN15-50)
- Type 517 (flange design, DN15-50)

All diaphragm valves shall be manufactured by Georg Fischer Piping Systems in accordance with EN ISO 16138. The upper body shall be PPGF (polypropylene glass fibre reinforced) connected to the lower body with a central union avoiding exposed screws. A two coloured position indicator integrated into the hand wheel must be present to determine diaphragm position. The hand wheel shall have an integrated locking mechanism. Diaphragms are to be EPDM, FPM, NBR, PTFE with EPDM or FPM backing diaphragm.

Following options shall be available:

- PN16 pressure rating
- Electrical feedback unit with either Ag-Ni or AU contacts
- Pressure proof housing

The diaphragm valve shall have following KV values:

d [mm]	DN [mm]	KV [l/min @ $\Delta P=1$ bar]
20	15	125
25	20	271
32	25	481
40	32	759
50	40	1263
63	50	1728

6.2.1.2 Manual Diaphragm Valves DN65 to DN150

All **PVC-U** diaphragm valves, with metric sizes DN65-150, shall be Type 317 (flanged design). All diaphragm valves shall be manufactured by Georg Fischer Piping Systems in accordance with EN ISO 16138.

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The upper body shall be PPGF (polypropylene glass fibre reinforced) connected to the lower body with exposed stainless steel bolts. A position indicator integrated into the hand wheel must be present to determine diaphragm position. Diaphragms are to be EPDM, FPM, NBR, or PTFE with EPDM or FPM backing diaphragm.

6.2.2 Pneumatic Diaphragm Valves

6.2.2.1 Pneumatic Diaphragm Valves DN15 to DN50

All **PVC-U** diaphragm valves, with metric sizes DN15-50, shall be:

- true double union design, DN15-50
- spigot design, DN15-50
- flange design, DN15-50

All diaphragm valves shall be manufactured by Georg Fischer Piping Systems in accordance with EN ISO 16138. The upper body shall be connected to the lower body with a central union nut avoiding exposed screws. Diaphragms are to be EPDM, FPM, NBR, PTFE with EPDM or FOM backing diaphragm.

The diaphragm valve shall have following KV values:

d [mm]	DN [mm]	KV [l/min @ $\Delta P=1$ bar]
20	15	125
25	20	271
32	25	481
40	32	759
50	40	1263 (960*)
63	50	1728 (1181*)

* DIASTAR Six

Pneumatic actuators shall be Georg Fischer Piping Systems Type DIASTAR and shall be available as

- DIASTAR Six for PN up to 6bar,
- DIASTAR Ten for PN up to 10bar,
- DIATARR TenPlus of PN up to 10bar both sides,
- DIASTAR Sixteen for PN up to 16bar

The mode of operation shall be fail safe close (FC), fail safe open (FO) and double acting (DA). The valves shall have an integrated optical position indicator. Actuator housing shall be made of PPGF (polypropylene glass fibre reinforced).

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Actuators with FC mode shall contain a preloaded galvanised steel spring assembly to ensure safe actuator operation and maintenance.

The actuator DIASTAR Ten, DIASTAR TenPlus and DIASTAR Sixteen shall have following accessories available:

- Solenoid pilot valve remote or direct mounted in voltages 24VDC/AC, 110VAC, 230VAC
- Positioner Type DSR 500-1
- Feedback with following limit switches Ag-Ni, Au, NPN, PNP, NAMUR
- Stroke limiter & emergency manual override
- ASI controller

6.2.2.2 Pneumatic Diaphragm Valves DN65 to DN150

All **PVC-U** diaphragm valves, with metric sizes DN65-150, shall be flanged design. All diaphragm valves shall be manufactured by Georg Fischer Piping Systems in accordance with EN ISO 16138. The upper body shall be connected to the lower body with exposed stainless steel bolts. Diaphragms are to be EPDM, FPM, NBR, or PTFE with EPDM or FPM backing diaphragm.

Pneumatic diaphragm actuators shall be Georg Fischer Piping Systems Type DIASTAR Type 025. The mode of operation shall be fail safe close (FC), fail safe open (FO) and double acting (DA). The valves shall have an integrated optical position indicator. Actuator housing shall be made of PPGF (polypropylene glass fibre reinforced). Actuators with FC mode shall contain a preloaded galvanised steel spring assembly to ensure safe actuator operation and maintenance.

The actuator DIASTAR 025 shall have following accessories available:

- Solenoid pilot valve remote or direct mounted in voltages 24VDC/AC, 110VAC, 230VAC
- Positioner Type DSR 500-2
- Feedback with following limit switches AgNi, Au, NPN, PNP, NAMUR
- Stroke limiter & emergency manual override
- ASI Controller

6.3 Butterfly Valves

All **PVC-U** butterfly valves, with metric sizes DN50-400, shall be Georg Fischer Piping Systems Type 567 / 563 (wafer type) or 568 / 578 (lug type) with a double eccentric disc design manufactured by Georg Fischer Piping Systems in accordance with EN ISO 16136. Seals shall be available in both EPDM and FPM. The lever handle shall be lockable in increments of 5 degrees.

There shall always be six teeth engaged between the ratchet and the index plate to ensure accurate and safe positioning of the lever. There shall be the option of fine adjustment by use of a specific hand lever, allowing the disc to be exposed at any angle between 0° und 90°. As an option, the hand lever shall be lockable. The hand lever shall be manufactured of high strength PPGF (polypropylene glass fibre reinforced). The option of an integrated electric position indicator shall be available. Optional the valves can be actuated by gear box with hand wheel. The electric position indicator shall be integrated into the mounting flange. Butterfly valves shall have low actuation torque to enable easy operation. All butterfly valves Type 567 / 568 / 578 manufactured by Georg Fischer Piping Systems are designed for a nominal pressure rate of 10bar. All butterfly valves Type 563 are designed for a nominal pressure rate of 4bar.

6.3.1. Electric Butterfly Valves

Electric actuators shall be Georg Fischer Piping Systems Types EA31 or EA42 dependent on valve size. They shall be manufactured by Georg Fischer Piping Systems in accordance with EN 61010-1, as per the above specifications. Actuator housing shall be made of PPGF (polypropylene glass fibre reinforced), flame retardant and feature external stainless steel screws. All electric actuators shall have an integrated emergency manual override and integrated optical position indication.

All electric actuator types shall have the following accessories available:

- Fail-safe unit
- Heating element
- Cycle extension, monitoring, and counting
- Motor current monitoring
- Position signalisation
- Positioner Type PE25
- Limit switch kits AgNi, Au, NPN, PNP
- Manual override
- AS-Interface Plug Modul

6.3.2 Pneumatic Butterfly Valves

Pneumatic actuators shall be Georg Fischer Piping Systems Types PA 35 (metric sizes DN50-65), PA40 (metric size DN80), PA45 (metric sizes DN100-125), PA55 (metric sizes DN150-200), PA60 (metric size DN200 FC), PA65 (metric size DN250 FC) PA70 (metric size DN300 FC). They shall be supplied by Georg Fischer Piping Systems. Pneumatic actuators shall be available as fail safe close, fail safe open and double acting and have an integrated optical position indication.

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Actuator housing shall be made of hardened anodized aluminium. Actuators shall contain integrated Namur interfaces for the easy mounting of positioners, limit switches and accessories.

All pneumatically actuated butterfly valves shall have the following accessories available:

- Solenoid pilot valve remote or direct mounted in voltages 24VDC/AC, 110VAC, 230VAC
- Positioner Type DSR 500-3
- Feedback with following limit switches AgNi, Au, NPN, PNP, NAMUR
- Stroke limiter & emergency manual override
- ASI-controller

6.4 Angle Seat Valves

All **PVC-U** angle seat valves, Type 300 shall be manufactured by Georg Fischer Piping Systems according to EN ISO 21787 and overall length according to EN 558, available in metric sizes DN10-80, with an internal piston cone end in PE or PTFE, and solvent cement spigots. The angle seat valves manufactured by Georg Fischer Piping Systems are designed for a nominal pressure rate of 10bar.

6.5 Check Valves

6.5.1 Cone Check Valves

All **PVC-U** cone check valves, according to EN ISO 16137, with metric sizes DN10-100, shall be Type 561 / 562 true double union design. Seals shall be EPDM or FPM, FFFPM can be an option. Union bushes shall have a left hand thread to prevent possible unscrewing when threaded end connectors are removed from pipe. This valve shall be suitable for mounting in a vertical and horizontal position. Type 562 shall be equipped with a spring made of stainless steel (V2A) or as an option stainless steel HALAR coated or Nimonic 90 to allow position independent installation. The valves are designed for a nominal pressure of 16bar. Type 561 shall be leakproof from a water column of 2m (0.2bar). Type 562 shall be leakproof from a water column of 1m (0.1bar).

6.5.2 Angle Seat Check Valves

All **PVC-U** angle seat check valves Type 303 shall be manufactured by Georg Fischer Piping Systems according to EN ISO 16137 and overall length according to EN 558-1, available in metric sizes DN10-80 with EPDM or FPM seals and with solvent cement spigots.

The Angle Seat Check Valves shall be leakproof from a water column of 2m for EPDM and 3m for FPM seals as supplied by Georg Fischer Piping Systems. The angle seat check valves manufactured by Georg Fischer Piping Systems are designed for a nominal pressure rate of 10bar.

6.5.3 Wafer Check Valves

All **PVC-U** wafer check valves, with metric sizes DN32-300, shall be Georg Fischer Piping Systems Type 369. The minimum water column of 2 m is required for sealing. They must be equipped with a spring (either in 316 stainless steel or Hasteloy C) guaranteeing closure in all installation positions. Attention: A stabilizing pipe zone of at least 5 times nominal diameter (DN) (recommended 10 times nominal diameter) before and after the wafer check valve should be provided.

6.6 Pressure Regulating Valves

Pressure ranges for all **PVC-U** pressure regulating valves as supplied by Georg Fischer Piping Systems are the following:

- DN10-50 max. 10bar
- DN65-80 max. 6bar
- DN100 max. 4bar

6.6.1 Pressure Reducing Valves

All **PVC-U** pressure reducing valves, manufactured by Georg Fischer Piping Systems, reduce the pressure within the system to a pre-set value. By using the differential pressure, the pressure reducing valve adjusts itself to the set working pressure. The outlet pressure (working pressure) is not directly related to the inlet pressure. If the outlet pressure increases above the set value, the diaphragm is lifted against the spring force. If the outlet pressure falls below the set value, the diaphragm is pressed down by the spring force. The pressure reducing valve begins to close/open until a state of equilibrium is re-established; in other words, the outlet pressure remains constant irrespective of an increasing or decreasing inlet pressure.

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Following types and sizes are available:

- Type 582, compact Pressure Reducing Valve, sizes DN10–50

Features:

- Metal free central housing union nut
 - Set pressure selectable 0.5 - 9 bar or 0.3 – 3 bar
 - Manometer optional
 - Manometer assembly possible on both sides
 - Selection of direct manometer assembly or with gauge guard
 - Possibility to show either inlet or outlet pressure
 - Injection molded directional arrow for direction of flow
 - Threaded inserts for assembly
- Type V82, Pressure Reducing Valve with an integrated manometer, sizes DN50-100

6.6.2 Pressure Retaining Valves

All **PVC-U** pressure retaining valves, manufactured by Georg Fischer Piping Systems, serve to keep the working or system related pressures constant, to balance out pressure pulsation, and to reduce pressure peaks in chemical process systems. If the inlet pressure rises above the set value, the pressurized valve piston is lifted against the spring force. Consequently, the valve opens and there is a reduction of pressure through the outlet pipe. The valve closes as soon as the inlet pressure sinks below the pre-set spring tension. Following types and sizes are available:

- Type 586, compact Pressure Retaining Valve, sizes DN10-50

Features:

- Metal free central housing union nut
 - Set pressure selectable 0.5 - 9 bar or 0.3 – 3 bar
 - Manometer optional
 - Manometer assembly possible on both sides
 - Selection of direct manometer assembly or with gauge guard
 - Possibility to show either inlet or outlet pressure
 - Injection moulded directional arrow for direction of flow
 - Threaded inserts for assembly
- Type V86, Pressure Retaining Valve, sizes DN65-100

6.7 Direct-acting Solenoid Valves

Direct-acting solenoid valves as supplied by Georg Fischer Piping Systems serve to regulate and control fluids, if no compressed air is available or not wanted. They are used for diverse functions, e.g. opening, shutting, dosing, distribute and mixing. The medium flow is switched directly by the armature moved by the magnetic force. Safety position shall be available.

Following type and sizes are available:

- Type 157, sizes DN4-8
- Type 160/161, sizes DN10-20

6.8 Servo-assisted Solenoid Valves

Servo-assisted solenoid valves as supplied by Georg Fischer Piping Systems serve to regulate and control fluids, if no compressed air is available or unwanted. They are used for miscellaneous functions, e.g. opening, shutting, dosing, distributing and mixing. Opening large orifices using the direct-acting method would require enormous and expensive coils. Servo assisted valves use the power of the fluid to open the flow channel by controlling a small pilot channel to alter the forces on a larger main seal. A minimum differential pressure of 0.5bar is required to fully open the valve.

Following type and sizes are available:

- Type, 165, sizes DN10-50

6.9 Ventilating- and Bleed Valves

All **PVC-U** ventilating- and bleed valves shall be Georg Fischer Piping System type 591. Dimensions DN10-100 are with pressure rating PN16. They shall be equipped with a PP-H floater with density of 0.91 g/cm^3 .

6.10 Ventilating Valves

All **PVC-U** ventilating valves shall be Georg Fischer Piping System type 595. Dimensions DN10-100 are with pressure rating PN16. They shall be equipped with a coated stainless steel spring with minimal opening pressure (10-80 mbar).

7. Solvent Cement & Cleaner

For adhesive jointings, **PVC-U** cement with gap-filling adhesives must be used for solvent cementing. Georg Fischer Piping Systems recommends the Henkel cement system TANGIT PVC-U for all **PVC-U** solvent cement joints. All specifications are based on using TANGIT PVC-U, including strength and chemical resistance. For all other cements please refer to the manufacturers' instructions.

TANGIT PVC-U contains app. 20% **PVC-U**, dissolved in a blend of solvents. The solvents soften and macerate the edges of the surfaces they are applied to. Once the solvents have evaporated, they leave a homogenous joint with the same mechanical, thermic and chemical properties as of the **PVC-U** pipe system.

The jointing surfaces of pipe and fitting must be clean and free of grease. They must be cleaned with TANGIT cleaner.

For chemical concentrations $\geq 70\%$ sulphuric acid; $\leq 10\%$ chromic acid, $\geq 25\%$ hydrochloric acid; $\geq 20\%$ nitric acid; sodium hypochlorite $\geq 6\%$ active chlorine, $\geq 5\%$ hydrogen peroxide and hydrofluoric acid in any concentration, subject to the application and operating conditions, Dytex solvent cement and Dytex Cleaning for PVC-U, manufactured by Henkel, must be used in accordance with the instruction of Henkel.

8. Measurement & Control / Instrumentation

The following parameters can be measured (Sensors), indicated and/ or transmitted (transmitters) to PLC, PC and other Data Acquisition Systems. All products comply with the CE standard.

Parameter	Technology	Compatible liquids (*)
Flow	Paddlewheel	clean liquids
	Rotameter	clean liquids
	Magmeter	contaminated liquids
	Ultrasonic	clean, ultra pure liquids
Level	Hydrostatic	all liquids
	Ultrasonic Continuous	all liquids
	Switches	all liquids
pH-ORP	Glas electrodes	all liquids
Conductivity	Contact	all liquids
Pressure	Piezoresistive	all liquids
Temperature	Pt1000	all liquids

(*) please check first the sensors limitations in material, pressure and temperature (data sheet) and chemical resistance list

8.1 Sensors

The sensors listed hereafter will transfer the measured value to a Georg Fischer Piping Systems Transmitter, to indicate the measured value and allowing simple calibration and maintenance of the devices. Alternatively the measured values of the sensors can be sent directly to a PLC, PC or other local made electronics using either an analogue signal (4-20 mA, open collector or sinusoidal voltage) or a digital signal called S³L (Georg Fischer Piping Systems Signet proprietary serial signal).

8.1.1 Installation Fittings

Depending on the sensor type, special installation fittings shall be used for connection to the pipeline: Installation T-Fitting metric sizes DN15-50 with double true union, Clamp-On Saddle metric sizes DN65-200, Glue-On Saddle metric sizes DN65-300 and weld on fittings (weld-o-let) metric sizes DN65-600. Sensor thread connection for flow- and pH-sensors shall be 1 ¼" NPSM. For all further sensors standard adaptor sockets or nipples with ½", ¾" ISO, or ¾" NPT thread shall be used.

8.1.2 Flow sensors

8.1.2.1 Paddlewheel sensors

515 and 525 sensors:

All sensors of this family are "sinusoidal" sensors. This sensor from Georg Fischer Piping Systems Signet requires no external power source to produce a signal. Internal to the body of the sensor is a wire coil which when excited by the rotor assembly produces a small sinusoidal signal. The rotor assembly consists of four paddles; inserted into each of the paddles of the rotor are magnets. As liquid flows past the rotor assembly it rotates each of the four paddles produces a sine wave signal as it passes the centre of the body (two paddles of the rotor produces a full AC sine wave).

The sensors as manufactured by Georg Fischer Piping Systems Signet produce a signal output which is proportional to the flow rate. A K-factor (number of pulses generated by the sensor per 1 litre or 1 gallon of fluid the sensor) is used to define the size of the pipe that the sensor is inserted into.

3-2536 and 3-2537 sensors:

All sensors of this family of sensors are "Hall Effect" sensors. Internal to the Georg Fischer Piping Systems Signet sensors body is an open collector relay.

The sensor is supplied with a voltage from the 3-8550 transmitters or an external power supply ranging from 5 to 24 volts. This voltage is switched through the open collector relay as the paddlewheel (rotor) of the sensor rotates. The sensor's rotor assembly has four paddles. Inserted in two of the paddles is a magnet. As the paddles pass the centre of the sensors body, the magnetic field switches the open collector relay on and off which generates a square wave pulse as manufactured by Georg Fischer Piping Systems Signet. Two pulses indicate a complete rotation (on/off cycle) of the open collector relay. The pulse output is directly proportional to the fluid velocity. A K-factor (number of pulses generated by the sensor per 1 litre or 1 gallon of fluid passing the sensor) is used to define the size of the pipe that the sensor is inserted into.

8.1.2.2 Rotameters

Rotameters, as supplied by Georg Fischer Piping Systems, are radially installed dismountable meters for flow rate measuring in industrial piping applications. If needed, minimum or maximum flow can also be monitored via limit switches. Also, analogue flow measurement with a 4-20mA Signal is possible.

The working principle of the rotameter is based in gravity and equilibrium of forces. If a medium flows upwards at a sufficient flow rate through the vertically mounted taper tube, the float is raised to the point at which a state of equilibrium sets in between the lifting force of the medium and the weight of the float. Since the mean rate of flow is proportional to the quantity flowing through per unit of time, this state of equilibrium corresponds to the measurement of the instantaneous flow rate.

Following types and sizes are available:

- Type SK, DN10-65
- Type 335, DN25-65
- Type 350, DN25-65

8.1.2.3 Magmeters

The Magmeter sensor from Georg Fischer Piping Systems Signet consists of two metallic pins that produce a small magnetic field across the inside of the pipe. The Magmeter measures the velocity of a conductive liquid (20 μ S or greater) as it moves across the magnetic field. A voltage occurs on the sensor tips, which is directly proportional to the flow rate of the fluid. The magnetic signal is conditioned and translated in to a pulse signal. A K-factor (number of pulses generated by the sensor per 1 litre or 1 gallon) is used to calculate the flow volume. The Magmeter of Georg Fischer Piping Systems Signet is offered as a blind frequency, 4-20 mA or digital S³L signal, or with integral display and control relays.

8.1.2.4 Ultrasonic Flowmeter

The U3000/4000, the PF220/330 and the U1000 from Georg Fischer Piping Systems are transit time ultrasonic flow meters, designed to work with clamp-on transducers, to provide accurate measurement of liquid flowing within a closed pipe, without the need for any mechanical parts to be inserted through the pipe wall or to protrude into the flow system. It takes just a few minutes to install and there is no need to shut down flow or drain the system! From process control in industrial applications, to water management from raw to deionized water, the Ultraflow U1000/U3000/U4000 for fixed installation and the Portaflow PF220/330 for portable flow monitoring cover a wide spectrum of flow monitoring and process control in many industries.

Using ultrasonic transit time techniques enables to be used with pipes having an outside diameter range from d13 to d2000 as standard and up to d5000 as an option. The instruments will also operate over a wide range of fluid temperatures. All of the Ultrasonic Flowmeters have the same basic features. However, the standard U4000 and PF330 can also perform data logging and allows site details and flow data to be reordered with a memory, that is able to log more than 150 000 separate readings. The standard U4000 and PF330 is also capable of downloading the stored data via the USB or RS232 interface to the Portagraph software supplied with the unit.

8.1.3 Level Sensors and Level Switches

8.1.3.1 Hydrostatic Level Sensors

Hydrostatic pressure is the pressure exerted on a column of fluid by the weight of the fluid above it. Internal to the Georg Fischer Piping Systems Signet PVDF sensor body is a ceramic diaphragm sensor and capillary tube/cable assembly. The ceramic diaphragm sensor exposed to the fluid senses the hydrostatic pressure of the fluid and compares the pressure to the atmospheric pressure monitored the capillary tube/cable assembly. The hydrostatic level sensor from Georg Fischer Piping Systems Signet only senses the hydrostatic pressure of the fluid. The Level Sensor is offered as a blind output 4-20 mA or digital S³L output connected to the Georg Fischer Piping Systems Signet Transmitter unit.

8.1.3.2 Ultrasonic Level Sensors (Series 2260 / 2270)

Ultrasonic level sensors are non-contact devices, using the travel time of sound and its reflection, for measuring the distance to a liquid or solid surface. Based on this information, Georg Fischer Piping Systems sensors are capable of calculating a liquid level or volume. Their outstanding narrow 5° beam, allow reliable measurement even at the presence of disturbing objects or when space is limited. The Georg Fischer Piping Systems portfolio contains sensing ranges 4 m, 6 m and 15 m.

Sensors with integrated display or blind sensors are available and provide 4-20 mA, HART protocol or relay outputs.

Georg Fischer Piping Systems ultrasonic level sensors are compatible with Georg Fischer Piping Systems transmitters, indicators, controllers and valve actuators.

8.1.3.3 Point Level Switches (Series 2280)

The Georg Fischer Piping Systems portfolio of point level switches contains various different detection technologies, to provide a solution for various liquids and application requirements.

- Type 2280
Vibration Forks detect a liquid level with two vibrating stainless steel wings. In air they vibrate with a specific, calibrated frequency. By the contact with a liquid the frequency changes which forces an electrical output to switch. Georg Fischer Piping Systems vibration forks are equipped with digital PNP/NPN or relay output. Versions with ATEX or WHG approval are available.
- Type 2281
Conductive Multipoint Switch contains up to 5 stainless steel electrodes, which allow to detect 4 different liquid levels in a tank. Up to 2 external relay pairs allow to switch pumps or valves. Georg Fischer Piping Systems conductive multipoint switches work with liquids of min. 10 μ S conductivity. Their four-in-one design allows fast installation and provides attractive solutions concerning costs.
- Type 2282
Guided Float Switches are equipped with an air filled float with embedded magnet. Rising liquid lifts up the float. The magnetic field forces a reed contact to switch. Georg Fischer Piping Systems guided float switches are available in PP and PVDF to provide best chemical compatibility to corrosive liquids.
- Type 2284
Ultrasonic Gap Switches are equipped with an ultrasonic transducer and receiver in their fork tips. Based on the switch design, the sound waves are damped in air. Thus the output is disabled. In contact with liquid the sound waves start to travel from transmitter to receiver, which enables the output. Georg Fischer Piping Systems ultrasonic gap switches provide an electronic relay output which allows to control pumps and valves. Thanks to their PPS full-plastic body they provide a very high resistance against mechanical impacts and corrosive liquids. They work with no moving parts, so they do not require any maintenance.

- Type 2285

Float Switches are primarily used in open basins and pump shafts for detecting liquid level. In an empty tank they hang in vertical position, attached to the tank wall at their cable. Rising liquid carry them on the liquid surface. At an angle of approximately 45° an integrated switch is enabled. Georg Fischer Piping Systems float switches are double chambered and equipped with a mercury-free switch. Hence they may be used for drinking and for waste water applications.

8.1.4 pH Sensors

All pH sensors from Georg Fischer Piping Systems Signet are constructed as combination electrodes. One electrode is comprised of a pH sensitive glass stem. The other electrode uses a silver / silver chloride reference electrode. Both electrodes are contained within a common housing. The measuring cell is constructed of hydrogen sensitive glass that can detect the concentration of hydrogen ions (+H) in a solution. The concentration of +H ions directly determines the pH value of the fluid. The reference cell is used to provide a stable reference signal. The pH signal is measured against a stable reference signal. The reference junction allows the reference cell to come in contact with the fluid being measured. The measured signals are then conditioned and sent as a blind 4-20 mA or as a digital S³L signal to the Georg Fischer Piping Systems Signet Transmitter unit. All sensors are equipped with integrated temperature compensation.

8.1.5 ORP Sensors

All ORP sensors from Georg Fischer Piping Systems Signet are constructed as combination electrodes. One electrode is comprised of a noble metal such as platinum or gold. The other electrode is a silver/silver chloride reference electrode. Both electrodes are contained within a common housing. Temperature compensation is not used in ORP measurements.

ORP is an abbreviation for Oxidation-Reduction Potential. Oxidation is a term used to denote the occurrence of a molecule losing an electron. Reduction occurs as a molecule gains an electron. The "potential" is simply an indication of a solution's propensity to contribute or accept electrons. ORP reactions (sometimes referred to as REDOX) always take place simultaneously. There is never oxidation without reduction, and ORP electrodes are used to detect electrons exchanged by molecules as these reactions occur.

The measured signals are conditioned and sent as a blind 4-20 mA or as a digital S³L signal to the Georg Fischer Piping Systems Signet transmitter unit.

8.1.6 Conductivity Sensors

All Conductivity sensors from Georg Fischer Piping Systems Signet are manufactured using two stainless steel electrodes. Alternative materials are available in case of chemical incompatibility. Conductivity sensors measure the ability of a fluid to conduct an electrical current between two electrodes.

The proper term for this ability of a solution is electrolytic conductivity, since only ions conduct electric current in solution. Electrolytic conductivity (or simply conductivity) is therefore an indirect measure of the ionic concentration of a solution. Generally, conductivity increases and decreases with the concentration of ions.

Most conductivity electrodes consist of two measuring half-cells. The geometry of the half-cells can be tailored to provide highly accurate measurements over a specific conductivity range. Cell constants help to describe electrode geometry for the purpose of selecting the appropriate electrode for a given application. A cell constant is defined as the length between the two half cells divided by the area of the cells. All conductivity sensors have a temperature compensation circuits in order to increase the sensors accuracy.

The measured signals are then conditioned and sent as a blind 4-20 mA or as a digital S³L signal to the Georg Fischer Piping Systems Signet Transmitter unit.

8.2 Multi Parameter Instruments

8.2.1 Transmitters

The Georg Fischer Piping Systems Signet 9900 Transmitter provides a single channel interface for many different parameters including Flow, pH/ORP, Conductivity/Resistivity, Salinity, Pressure, Temperature, Level, Dissolved Oxygen and other sensors that output a 4-20 mA signal. The display shows separate lines for units, main and secondary measurements as well as a dial-type digital bar graph. The 9900 is offered in both panel or field mount versions. Both configurations can run on 12 to 32 VDC power (24 VDC nominal). The 9900 can also be loop powered with compatible sensors. Designed for complete flexibility, plug-in modules allow the unit to easily adapt to meet changing customer needs. Optional modules include Relay, Direct Conductivity/ Resistivity, H COMM and a PC COMM configuration tool.

- 1 sensor input (Flow, pH/ORP, Conductivity/Resistivity, Salinity, Pressure, Temperature, Level, Dissolved Oxygen and other sensors that output a 4-20 mA signal, Signet 8058 i-Go™ Signal Converter required)
- 1 analogue output (4-20 mA), 2nd optional analogue output is available
- 1 Open Collector output
- Optional relay module with 2 Dry Contact Relay SPDT
- Power supply 12-32 VDC

8.2.2 Batch Controller

The batch controller manufactured by Georg Fischer Piping Systems Signet Type 9900 is based on the Transmitter. It allows batching a pre-selected quantity of liquid. After selection of the quantity to be dosed, a start signal (local or remote) will close a batch controller contact to energize or de-energize a valve and/or switch on a pump. The batch controller counts the pulses coming from any Signet sensor with frequency output and stops the batch process as the pre-selected quantity is reached.

Advanced features include a user-set security code, an automatic calibration option, and overrun compensation. The batch process is repeatable and is designed for intensive industrial applications.

8.2.3 Multi-Parameter Controller

The Georg Fischer Piping Systems Signet 8900 Multi-Parameter Controller takes the concept of modularity. Each 8900 is field commissioned with the user's specified combination of inputs, outputs, and relays using simple-to-install modular boards into the base unit. Configure the system by selecting either two, four, or six input channels which accept any of the Signet sensors listed below, and/or other manufacturer's sensors via a 4-20 mA signal converter (Signet Model 8058). To complete your unit, choose a power module with universal AC line voltage or 12 to 24 VDC. Analogue output and relay modules are available and easily installed. Derived measurements include difference, sum, ratio, percent recovery, percent rejection, percent passage and BTU. The menu system can be programmed to display in multi-languages including English, German, French, Spanish, Italian, and Portuguese.

- 2, 4 or 6 sensor input (Flow, Level, pH-ORP, Conductivity, Pressure Temperature)
- 0, 2 or 4 analogue output (4-20 mA or 0-10 Volts)
- 0, 2, 4, 6 or 8 relay output
- Power supply 12-30 VDC or 110-230 VAC

9. Quality

9.1 Production Conditions

Pipes, fittings, solvent cement, cleaner, valves and accessories shall be manufactured in an environment operating a Quality Assurance System to ISO 9001 and an Environmental Management System conform to ISO 14001.

9.2 Marking

All components are embossed with a permanent identification during the production process to ensure full traceability.

The following information will be mentioned:

- Manufacturer's name or trade mark
- Production lot number
- Material
- Dimension
- Pressure rating

9.3 Uniformity

Pipes, fittings, valves, solvent cement and cleaner shall be supplied from one manufacturer, namely Georg Fischer Piping Systems, to ensure correct and proper jointing between components and uniform chemical and physical properties of the piping system.

9.4 CAD Library

All components shall be available in an online CAD library.

9.5 Training, Certification and Installation

Site personnel, involved with **PVC-U** piping installation, shall undergo training and certification from an authorised local institution prior to performing any jointing operations on site. For further information and training please contact Georg Fischer Piping Systems support under

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