Flowmeters

GEMÜ offers flowmeters operating according to the most varied physical measurement principles.

- Variable area flowmeter
- Flow transmitter
- Magnetically inductive flowmeter
- Ultrasonic flowmeter

All these types have their particular features and advantages and are therefore suitable for the most varied applications. The selection of the right measurement principle and its particular design depends on the working medium, the type of measurement required and the conditions prevailing in the plant or machine. The following factors must be considered in detail:

Medium:

- Temperature
- Conductivity
- Density
- Pressure
- Corrosiveness
- Abrasivity
- Viscosity
- Homogeneity
- Aggregate state

Pipeline:

- Quantity / nominal size
- Inlet and outlet distances
- Flow
- Disturbances
- Pressure loss

Measurement:

- Measuring range / dynamics
- Mass or volume
- Accuracy

Flowmeter in an industrial application

UHP water treatment in the semiconductor industry

Flowmeters





Type	GEMÜ 800	GEMÜ 850	GEMÜ 840	GEMÜ 800 HP	GEMÜ 850 HP
Measuring range liquids[1]	0.5 - 33.000 l/h	0.1 - 1600 l/h	2.5 - 50 m³/h	200 - 7000 l/h	20 - 1000 L/h
Measuring range gas/air[1]	0.2 - 450 Nm³/h	0.02 - 37.5 Nm³/h	-	-	-
Nominal size	DN 20 to 65	DN 10 to 25	DN 20 to 65	DN 15 to 50	DN 15 to 25
Operating temperature[2]	-20 to 120 °C	-20 to 120 °C	-20 to 120 °C	-20 to 120 °C	-20 to 120 °C
Operating pressure[2]	Max. 10/15 bar	Max. 10/15 bar	Max. 10/15 bar	Max. 10 bar	Max. 10 bar
Metering tube material	PA, Polysulphone (PSU), PVC, PVDF	PA, Polysulphone (PSU), PVC, PVDF	Main flow: PVC, PP Part flow: Polysulphone	PVDF	PVDF
Float material	PP, PVC, PVDF, stainless steel	PP, PVC, PVDF, stainless steel	PP, PVC	PVDF	PVDF
Union/ connection	PP, PVC, PVDF, stainless steel, malleable iron	PP, PVC, PVDF, stainless steel, malleable iron	PVC, PP, stainless steel	PVDF	PVDF

[1] dependent on medium, [2] dependent on the materials and the pressure-temperature curve of the materials

Water treatment plant

PVDF

PA 6-3-T

PSU

Variable area flowmeter

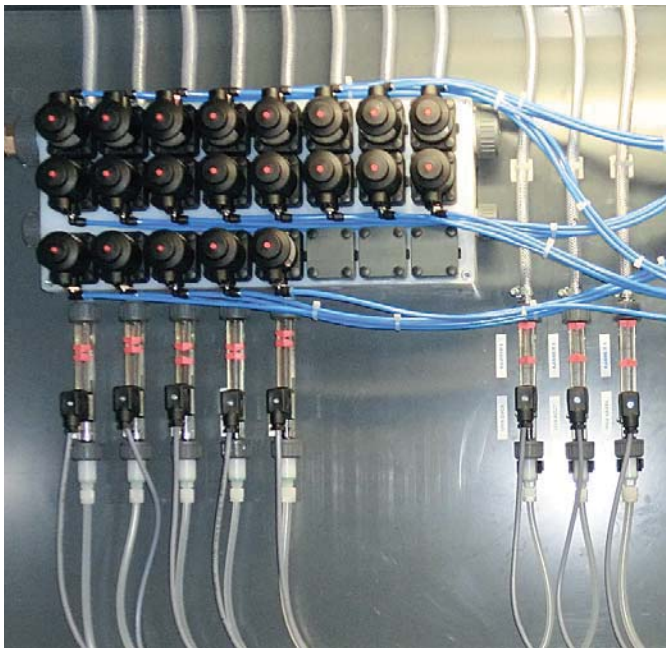
GEMÜ 800, 840, 850

Technical specifications:

Working medium:	Liquids and gas/air
Measuring range:	0.1 to 33,000 l/h for liquids 0.02 to 450 Nm³/h for air
Accuracy:	± 1% of end value and ± 3% of measured value
Operating pressure:	max. 15 bar, dependent on the design
Media temperature:	-20 to 100 °C (depending on metering tube material)
Available materials:	Metering tubes in PSU, Trogamid, PVDF, PVC
Nominal sizes:	DN 15 to 65
Automation capability:	Mounting of electrical limit switches or instrument sensors with reed contacts possible
Particulars:	Over 13,000 special scales available, further scales on request. GEMÜ 840 operates according to the part flow principle

GEMÜ 800/850

GEMÜ 840



Flowmeters

Limit switches

GEMÜ 1250 - 1257

Features

- Change-over contact GEMÜ 1250
- Limit switch max. contact GEMÜ 1251, 1256
- Limit switch min. contact GEMÜ 1252, 1257
- Can be combined with magnetic floats
- IP 65

GEMÜ 1251/1256
for
GEMÜ 800: DN 25 to 65
GEMÜ 850: DN 25

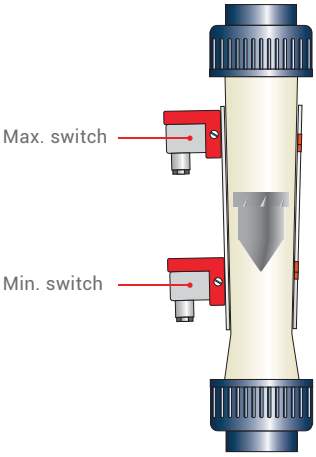
GEMÜ 1252/1257
for
GEMÜ 850: DN 10 to 20

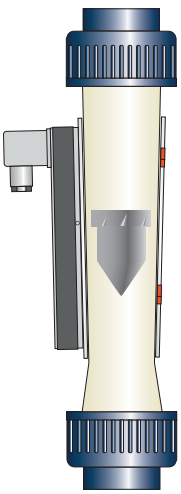
Instrument sensors

GEMÜ 1270 - 1273

Features

- Electrical instrument sensors with reed contacts for electrical signal transmission
- Can be combined with magnetic floats
- Output signal 1270/1271: 0 – 10 kΩ
- Output signal 1272/1273: 4 – 20 mA
- IP 65
- Raster of reed contacts dependent on version 2.3 – 4.25 mm





Flow transmitter

GEMÜ 3020, 3021

Technical specifications:

Working medium:	Liquids
Viscosity:	≤ 120 mm²/s
Measuring range:	120 to 25.000 L/h
Accuracy:	± 1% FS (of end value of measuring range)
Reproducibility	± 0.5% FS (of end value of measuring range)
Operating pressure:	max. 10 bar at 20 °C
Media temperature:	0 to 80 °C
Available materials:	Turbine PVDF, turbine body PVC and PVDF
Nominal sizes:	DN 25, DN 50
Automation capability:	Frequency output 0/4 to 20 mA, current output 0 to 10 V, relay signal inputs via PLC or remote operation
Particulars:	Freely scalable measuring range Designed as transmitter and measurement device, GEMÜ 3021 available as batch controller or totalizer

GEMÜ 3020

GEMÜ 3021

Magnetically inductive flowmeter

GEMÜ 3030

Technical specifications:

Working medium:	Liquids
Conductivity of medium:	≥ 20 µS/cm
Measuring range:	0 to 4 m/s, 0 to 10 m/s
Accuracy:	≤ 1% (of end value of measuring range), dependent on installation situation
Operating pressure:	max. 10 bar
Media temperature:	0 to 135 °C
Material of sensor rod:	1.4435/TFM, 1.4435/PEEK
Nominal sizes:	DN 25 to 300
Automation capability:	Frequency output 0/4 – 20 mA, pulse, relay, interface RS-232, Profibus-DP
Particulars:	Choice of measuring ranges, adjustable to changing operating conditions on site

Overview of plastics

Raw materials for plastics comprise homogeneous basic elements, so-called monomers, these being joined to one another in a chemical reaction. At the same time, the C-C double bond is broken with the polymer being formed through linking of the individual molecules.

These chemical reactions are termed polymerisation (subdivided into homopolymers, unipolymers, copolymers and block polymers), polycondensation and polyaddition. The degree of polymerisation is important for thermoplastics and, as a result, the tensile strength, hardness, elongation at fracture and impact strength increase as the degree of polymerisation rises with simultaneous increase in the tendency towards crystallisation, swelling behaviour as well as stress crack formation.

Features

- Low weight due to low density
- Suitability for mass production
- Complex shapes can be produced economically in only a few work steps
- Variable colouration, good dye penetration ability
- Simple improvement of the mechanical properties (tensile strength, elongation at fracture etc.) by filling and strengthening materials
- Plastics have a good internal elasticity and deformation behaviour
- Favourable antifrictional properties
- High chemical resistance

Plastic pellets

Acrylonitrile butadiene styrene polymer – ABS

Acrylonitrile butadiene styrene polymer is an amorphous thermoplastic with many options for variation in its structure. The monomers styrene, butadiene and acrylonitrile form the polymer, which can be reinforced with glass fibres or glass beads. Blends, polyblends, transparent plastics (ABS with corresponding rubber components), copolymers (graft or terpolymers) and special materials are available. ABS is distinguished by high viscosity, also at low temperatures down to -40 °C. This is complemented by high hardness with good scratch resistance. ABS is used in precision and electrical engineering, vehicle construction and the furniture industry, applications including high-quality household appliances as well as pipes and fittings.

Features

- High impact resistance and notch impact strength also at very low temperatures
- Smooth surfaces for low pipe friction losses
- High rigidity
- Physiologically harmless
- No microbial growth on the surface
- Corrosion resistant
- Processing: Injection moulding, extrusion, hot forming, cementing, welding, bolting together (with thread-forming screws), machining
- Scratch-proof surface, very high surface gloss for Prof polymer
- Galvanising suitability
- Metal inserts can be embedded effectively owing to the high viscosity

Resistance to chemicals

- Resistant against:
  (Deviations result depending on the portion of the three components styrene, acrylonitrile and butadiene)
  Water, aqueous saline solutions, most diluted acids and alkalis, aliphatic hydrocarbons, mineral oils, animal and vegetable fats
- Not resistant against:
  Concentrated mineral acids, organic acids, aromatic and chlorinated hydrocarbons, solvents (esters, ethers and ketones)

Thermal properties

- ABS exhibits good thermal stability and can be used in applications from around -45 °C to 60 °C, sometimes to 80 °C.
- ABS is a good thermal insulator; Owing to the high thermal coefficient of linear expansion, this is to be taken into account in the design of pipe systems

Electrical properties

- ABS exhibits a high surface and volume resistivity at only very low electrostatic build-up and also has good electric insulating performance. This must be considered for applications where there is a risk of ignition or explosion.

Fire behaviour

- Burns with a sooting flame without dripping. In accordance with UL94, ABS is classified into the flammability classification HB (horizontal burning). Types with flame-retardant standardisation are available.

Disadvantages

- Not very weatherproof

Polyamides PA

Polyamides are construction plastics for many technical applications, in particular for machine elements. Apart from copolyamides and polyamide 6-3-T, all others are semi-crystalline. Amorphous polyamides such as PA 6-3-T are almost transparent and are used at GEMÜ for flowmeters amongst other applications.
Polyamides absorb the moisture reversibly and release it again, their properties changing in the process.
Areas of application include mechanical engineering, precision engineering, vehicle construction, electrical engineering, sanitation technology, as well as the construction and furniture industry.

Features

- (at high crystallinity) rigid and hard
- Very viscous after absorbing water
- High fatigue strength
- Good impact resistance and notch impact strength, increased with modified types
- Good abrasion and wear resistance
- Good hydrolysis resistance
- Good antifrictional and antiseizure properties
- Good tracking resistance and dielectric strength
- With injection moulding: Good flow velocity, tremendous demoulding capacity
- Processing: Injection moulding, extrusion, cementing (better with low crystallinity), welding, bolting together, machining, printing, painting, metallising in high vacuum, fluidised bed sintering, flame spraying or electrostatic coating

Resistance to chemicals

- Resistant against:
  Very many organic media, e.g. esters, ethers, many chlorinated hydrocarbons, aliphatic and aromatic hydrocarbons, numerous mineral oils, greases, petrol, saline solutions, some alcohols, halogenated aliphatics and aromatics, petrol, oils, greases, weak alkalis and (mineral) acids, diluted alkalis
- Not resistant against:
  Mineral acids, strong alkalis, solutions of oxidants, low aliphatic alcohols, acetone, ketones and aldehydes (only to a limited extent)

Thermal properties

- The application temperature is between approx. -40 to +80 °C, depending on the type. Heat-stabilised types are available, which can withstand a longer influence above 120 °C without harmful effects

Electrical properties

- The electrical properties depend on the water content. The favourable surface resistance prevents extensive static build-up. Good tracking resistance, good insulation capacity (also with the effects of moisture), low electrolytic corrosion and high dielectric strength distinguish this material

Fire behaviour

- PA burns bluish with a yellow edge, drips with crackling
- Most types of PA achieve fire class HB to V2 according to UL94, and up to V0 with flame retardant

Disadvantages

- Water absorption affects material properties. For permanent use with outside weathering; UV-stabilised types should be used above all with exposure to sunlight

Overview of plastics

Polypropylene
PP-H / PP natural / PP reinforced

Polypropylene has been manufactured on an industrial scale since 1957 through the polymerisation of propylene using Ziegler-Natta catalysts. It belongs to the group of olefins which also include polyethylene (PE). A distinction is made between the PP moulding compounds in homopolymers (PP-H), block-copolymer (PP-B) and random-block-copolymers (PP-R). PP-H is used in pipe construction and equipment, as it exhibits many favourable properties such as resistance to chemicals and corrosion, stress crack resistance and, above all, an excellent weldability.
PP is a semi-crystalline, extensively non-polar thermoplastic, exhibiting a higher rigidity, hardness and strength in comparison to PE. As a thermoplastic with the lowest density at around 0.9 g/cm³, it occurs with a crystallinity between 60 to 70%. The addition of nucleating agents results in a fine-grain structure, exhibiting an increased (cold) impact strength. A reinforcement comprising glass fibres or minerals is recommended for construction components subject to high stress.

Features

- Good chemical resistance
- Excellent weldability
- High thermal aging and heat distortion temperature
- Application temperature: 5 to +90 °C, depending on the pressure and medium
- High impact strength, which decreases slightly at temperatures below 0 °C
- Fire behaviour: Burns; in UL94 as HB (horizontal burning) according to DIN 4102 T1
- Low tendency to form stress cracks
- Processing by: Injection moulding, extrusion, extrusion blow moulding, hot forming, no effective bonding strength owing to high chemicals resistance and non-polar structure (after pre-treatment cementing with adhesive and contact bonding material), machining, printing, painting, metallising
- Requires stabilisation

Resistance to chemicals

- Resistant against:
  Aqueous solutions of inorganic salts, weak inorganic acids and alkalis, alcohol, some oils, solutions of standard washing liquors to +100 °C
- Not resistant against:
  Strong oxidants, halogenated hydrocarbons, ketones, chlorinated hydrocarbons, petrol and benzene. Swelling in aliphatic and aromatic hydrocarbons (especially at increased temperatures). Partially non-resistant upon contact with copper! Inserts made of copper, manganese, cobalt and their alloys are to be avoided!

Thermal properties

- PP is a good thermal insulator. Pure PP tends towards oxidation at high temperatures. Stabilised types are therefore used.

Electrical properties

- Favourable dielectric properties irrespective of temperature and frequency (hence no HF warming). The high electrical insulating properties lead to electrostatic build-up and dust attraction. On account of this electrostatic build-up, care must be taken in applications where there is a risk of ignition or explosion, or corresponding countermeasures are to be implemented.

UV resistance

- The short-wave UV spectra of sunlight damage the PP together with the atmospheric oxygen. A covering in the form of an insulation or by a coat of paint absorbing UV light should be attached or applied.

Polyvinylchloride, unplasticised – PVC-U

Polyvinyl chloride is a bulk plastic which has been produced on an industrial scale since the beginning of the 20th century, its use coming in third place behind polyethylene and polypropylene. It is now indispensable in many applications in industry as well as for products in everyday life. PVC exhibits a very good overall ecological balance on account of its high component of chlorine of around 56 % by weight. Different manufacturing methods give rise to the various PVC polymers PVC-U, PVC-P, PVC-C, PVC-E, PVC-S or PVC-M with special properties. These are determined by the average degree of polymerisation (K value). An increase in the K value therefore increases the viscosity, dimensional stability in heat and fatigue strength at simultaneous decrease in the processability. PVC-U is primarily used in pipe construction, also PVC-C and transparent PVC-S in lower quantities.
PVC-U is an amorphous, polar thermoplastic. The cementing of pipes and valve bodies made of PVC-U is generally carried out with highly-solvent, gap-filling solvent adhesives.

Features

- Very good chemical resistance
- Good resistance to light and weathering, if sufficiently stabilised
- Physiologically indifferent
- High mechanical strength, rigidity and hardness
- Application temperature: 0 to 60 °C, depending on the pressure and medium
- Fire behaviour: Highly sooting with yellow flame, self-extinguishing flammability class V0 according to UL94, building material class B1 (hardly flammable) according to DIN 4102
- Low stress crack formation
- Processing by: Injection moulding, extrusion, hot forming, cementing, welding, machinable

Resistance to chemicals

- Resistant against:
  Saline solutions, sea water, diluted and partially concentrated acid, diluted and concentrated alkalis, non-polar solvents, petrol, mineral oils, greases, alcohol, aliphatic hydrocarbons, elemental chlorine, relatively good against high-energy radiation. UV radiation reduces the impact resistance slightly
- Not resistant against:
  Polar, aromatic and chlorinated solvents, esters, chlorinated hydrocarbons, aromatic hydrocarbons, petrol, liquid halogens, sulphuric acid containing oleum, concentrated nitric acid. An application with gas is not recommended, as PVC-U valve bodies tend towards chip fracture

Thermal properties

- PVC-U is a good thermal insulator on account of the very low thermal conductivity. Despite the lower linear coefficient of thermal expansion, this must be taken into account in the design of pipes

Energy balance

- PVC-U is average in this respect. The energy balance is low during manufacturing, which has a positive effect in relation to the durability of the products

Polyvinylidenefluoride – PVDF

Polyvinylideneflouride is a semi-crystalline thermoplastic, which can be processed using the injection moulding process in contrast to PTFE. The combination of extreme thermal stability with the best chemical resistance of all plastics allows PVDF to be used in industrial line construction, in the foodstuff industry for packaging films and for coating measuring probes and loudspeakers thanks to its piezoelectric effects. PVDF has a fluorine content of 59 % and can be processed well into moulded parts in contrast to PTFE, which cannot be processed thermoplastically.

Features

- High strength and rigidity at high temperatures
- High fatigue strength
- High UV resistance
- High resistance to chemicals
- High impact strength even in the cold
- Very low water absorption
- Self-extinguishing
- Physiologically harmless
- No microbial growth
- No electrolytic corrosion
- Application temperature: -20 to 120 °C, depending on the pressure and medium

Resistance to chemicals

- Resistant against:
  Most organic and inorganic acids, aliphatic and aromatic hydrocarbons, alcohols and halogenated solvents, dry and moist halogens
- Not resistant against:
  Alkalis, alkali metals, highly alkaline amines, elemental fluorine. Slight swelling due to highly polar solvents

Thermal properties

- PVDF is a good thermal insulator. Owing to the high thermal coefficient of linear expansion, this is to be taken into account in the design of pipe systems

Overview of plastics

Electrical properties

- PVDF is a good electrical insulator. The high electrical insulating properties can lead to electrostatic build-up and dust attraction. On account of this electrostatic build-up, care must be taken in applications where there is a risk of ignition or explosion, or corresponding countermeasures are to be implemented

Fire behaviour

- Does not burn and is classified into flammability class V0 according to UL94. A material decomposition begins at 380 °C, elemental fluorine being released, which reacts exothermally to form hydrogen fluoride in the presence of water

Polysulphones – PES and PSU

Amorphous, polar thermoplastics exhibiting a high heat deflection temperature and resistance to chemicals. The transparent, partially crystal-clear material PSU is used for flowmeters at GEMÜ. Both materials are also used for mechanical, thermal and electrical construction parts which are subject to high stress and for which transparency is required. Polysulphones have a broad field of application in precision and electrical engineering, vehicle and aircraft construction as well as household appliances.

Features

- Good strength and rigidity at higher temperatures
- Low creep tendency at higher temperatures
- Good viscosity also at higher temperatures
- Water absorption affects mechanical strength similar to polyamide
- PES has a higher permanent application temperature than PSU
- Colour transparent, almost crystal-clear, can be dyed covered in various colours
- Physiologically harmless

Resistance to chemicals

- Resistant against:
  Diluted acids and alkalis, petrol, oils, greases, alcohols, hot water and steam (PSU), high-energy radiation and infrared radiation
- Not resistant against:
  PES without stabilisation not weatherproof and UV-resistant, polar organic solvents, esters, ketones, aromatic hydrocarbons and hydrocarbons containing chlorine, petrol

Thermal properties

- PSU has high permanent application temperatures, which are even higher for PES. Application temperatures range from -80 °C at good viscosity to 180 °C at low creep tendency

Electrical properties

- For polar plastics good electrical insulating properties and low dielectric losses also at higher temperatures and humidity

Fire behaviour

- Hardly flammable, pungent odour of incendiary fumes

Disadvantages

- Stress crack formation possible with some media; Notch impact sensitivity