1 Description

The compressed air counters testo 6441 ... 6447 are used to determine, monitor, control and protocolize compressed air consumption, therefore not only for the detection of leakages in compressed air systems, the allocation of costs according to the originator, but also for peak load management. For compressed air, in a similar way as counters for media such as current, water or gases, the testo compressed air counters 6441 ... 6447 provide transparency of consumption, thus raising the motivation of those responsible for the process regarding cost- and energy-saving measures.The compressedair counters testo 6441 ... 6447 record the norm volume flow of operational compressed air according to the calorimetric principle, which means that the measuring process is independent of the process pressure, and does not cause any permanent loss of pressure. While the thermal glass-coated ceramic sensor offers high robustness and fast response times, the integrated inflow and outflow pipes (6441 .. 6444) ensure optimum accuracy.

The programm of the compressed air counter series 6440 consists of three designs:

- DN 15 - 50 mm (testo 6441...6444)
  Compact design in four diameters with a permanently installed electronic sensor assembly on a pipe section with inflow and outflow stretches, for screwing in.

- DN 65 - 250 mm (testo 6446/6447)
  These models are delivered with a pipe section including welding flanges for installation, in various diameters. The necessary lengths of the inflow and outflow stretches are not covered by the pipe sections. In testo 6447, the sensor can be removed under pressure.

- Large DN 50 (testo 6445)
  Penetration probe for versatile application in all pipe diameters. It is delivered without pipe section, therefore with less accuracy than the designs above, cf. chapter B 14.

Overview of designs:

Diameter	Description	Design	Material	Chapter
DN 15 - 50 (1/2" - 2") mm 4 DN types	testo 6441...6444	Compact	Probe: stainless steel Pipe: stainless steel	B 3 - B 12
DN 65 - 250 mm 7 DN types	testo 6446/6447	- Standard (testo 6446) - With probe removal under pressure (testo 6447)	Probe: stainless steel Pipe: optionally stainless steel or galnized steel	B 3 - B 12
		- Special solutions for customer-specific pipe diameters can be delivered. Price and delivery times on request	Probe: stainless steel Pipe: stainless steel	
Larger DN 50 mm Variable pipe diameters	testo 6445	Penetration probe	Probe: stainless steel Pipe: none	B 14

B 2 Application

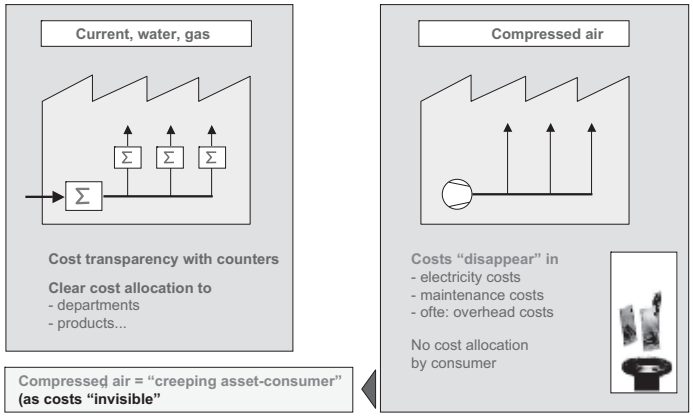
2 Application

For a cost-oriented industrial company, compressed air consumption measurement with the testo 6440 presents the optimum possibility of investing in savings in the area of compressed air. Because only by detecting leakages and allocating consumption by originator can high compressed air costs be lowered step-by-step . The testo 6440 is the ideal assistant for leakage detection, consumption cost allocation, peak load management, min./max. monitoring, for the control of consumption-dependent maintenance work, as well as for the exact automatic dosing of compressed air.

2.1 Cost transparency with compressed air counters

For media such as current, water or gases, complete transparency is guaranteed in every industrial company: Central counters reflect the quantities used; decentralized counters show how consumption is distributed.

The medium compressed air however, is produced and distributed internally, without knowing how much is used in total and in the individual departments. Without this knowledge, there is no motivation to eliminate leakages or achieve more economical use.

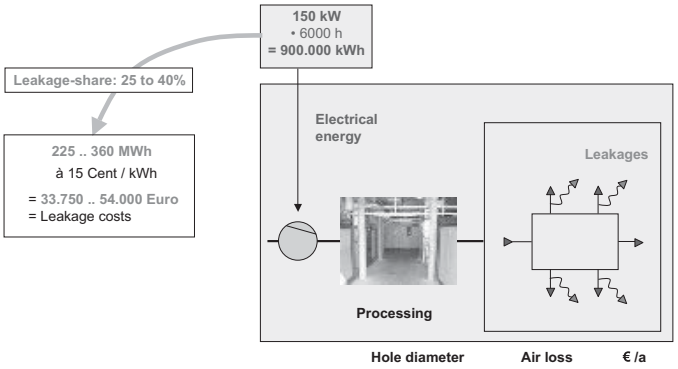


2.2 Leakage detection with the testo 6440

Independent investigations, for example by the Fraunhofer Institute in the course of the measurement campaign "Compressed air efficiency", have proven that between 25 and 40% of compressed air produced is wasted through leakage.

If the necessary extra investments, for example for pipeline systems, the compressors etc., are added to the operating costs, the wastage adds up to over 100,000 Euros per year in an average industrial company.

Leakage holes with a diameter of 3 mm, for example, already lead to costs amounting to 3,000 Euros per year.

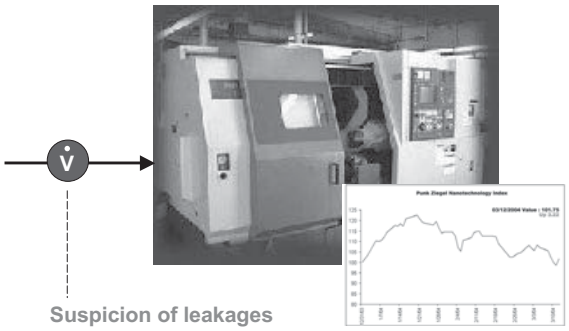


Hole diameter	Air loss	€ /a
3	3 m³/h	3.000.-
5	8.6 m³/h	7.700.-

Over 96% of leakages occur in pipes DN50 (2") and smaller. Leaky hoses, fittings, couplings and maintenance units are mainly responsible for this.

Installed in front of a machine or a machine group, the testo 6440 detects the smallest compressed air volume flows. These indicate leakages if they occur when the system is inactive.

It is also an indicator for leakage when known max.-volume flows are exceeded when the user profile is unchanged. The integrated switch outputs of the testo 6440 are thus the best leakage detector in practice.

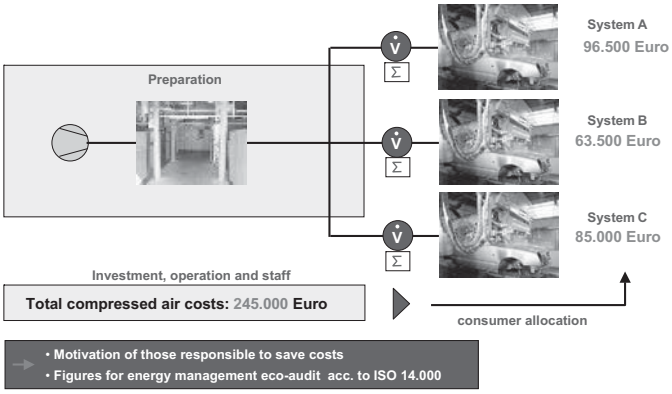


2.3 Lowering costs by consumer-allocation

Compressed air is a profitable, but also very costly energy source. If the high costs are only allocated as a "cost block", those responsible for the systems have no motivation to try and lower costs.

However, if the compressed air consumption of each system is recorded individually, the person responsible for the system is motivated to reduce leakages and to employ consumption-saving measures. The consumption quantities can also be used as figures on which to base the audit according to DIN EN ISO 14.000 for environmental management systems.

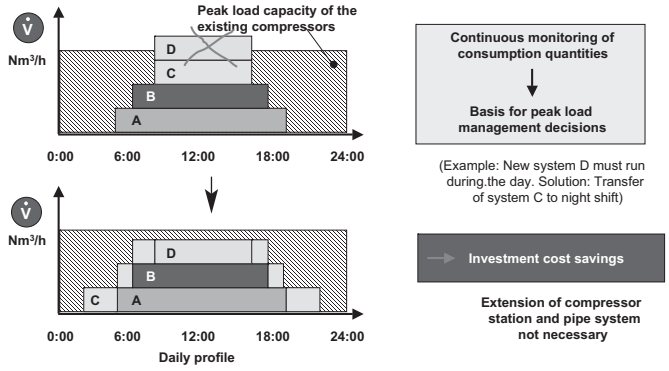
The testo 6440 provides optimal support here, in that it has a built-in totaliser function. The total consumption can be read directly from the instrument or registered in the regulating system via consumption impulses. Consumption-dependant switch outputs are alternatively also available, which can monitor consumption dependently or independently of time.



2.4 Peak load management helps to avoid extended investments

Growth can be expensive: Expanding industrial enterprises (example adjacent illustration: new system D) are forced to expand their compressed air production too.

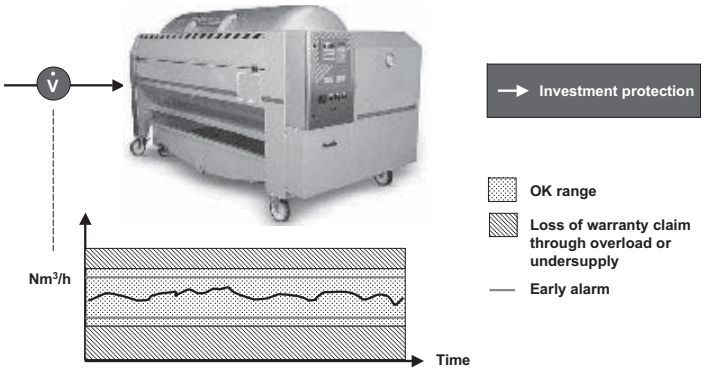
A peak load analysis on the basis of compressed air counters helps to avoid such investments. Since it is known when which consumption occurs, the distribution can be specifically regulated in the daily profile so that the existing capacity of compressed air production is sufficient. Considerable savings in the compressors as well as in the pipe system can be achieved.



B 2 Application

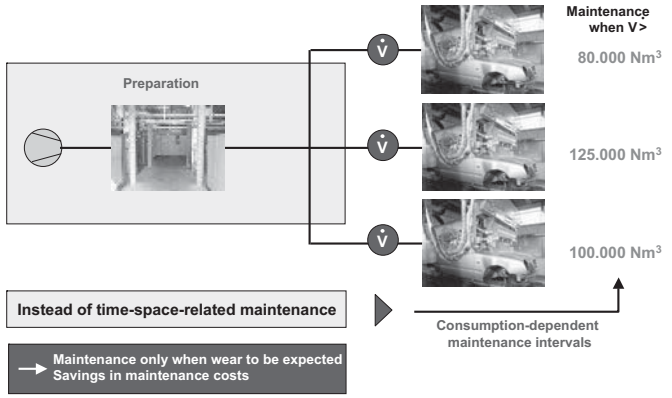
2.5 Protection of valuable compressed air consumersthrough min./max. monitoring

Compressed air consumers require a minimal supply in order to provide the desired performance.
Some consumers additionally have to be protected from too high a supply. In some cases, the warranty of the system's manufacturer is even dependent on this.
The testo 6440 performs both tasks optimally thanks to its two switch outputs (cf. illustration). For the continuous protection of your investment.



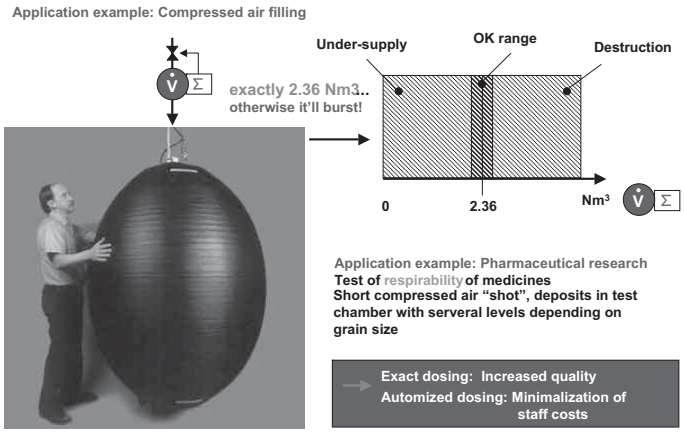
2.6 Consumption-dependent maintenance strategy

Maintenance is a service provided to ensure the availability of the machine or system. The primary objective of maintenance is to increase reliability and simultaneously lower costs. This main objective can be reached by selecting the optimum maintenance strategy. If we differentiate between the two strategies "breakdown-related maintenance" and preventive maintenance", in most cases the preventive measures are preferable from the point of view of risks (regarding the costs involved in a possible production breakdown). Preventive maintenance can again be broken down into time-space-oriented and consumption-oriented maintenance. The disadvantage of the time-space-oriented procedure is that either fully functional components are replaced too early, or that the actual time for replacement is missed, resulting in costly breakdowns. In order to counteract these disadvantages, the testo 6440 compressed air counter provides the optimum method for consumption-dependent maintenance. The maintenance engineer is simply "called onto site" with the help of the consumption-dependently programmable switch outputs. This allows the best possible exploitation of the expected lifetime of a machine or its components, resulting in considerable savings in costs (cf. illustration).



2.7 Automatic, exact dosing

In industrial systems, and also in the implementation of test series in research and development, an exact dosing of compressed air is often required, in order to guarantee the functionality of the system, to optimize the production process and to obtain test results always on the same basis.
In the area of pharmaceutical research, for example, test systems are used to determine the respirability of medicaments. Respirability is the characteristic of a material to reach the alveoli in the lung, i.e. in that part of the lung in which the gas exchange during breathing takes place. While a good respirability in contaminants can cause serious illnesses, in medicines it is desired for an optimum dosing and effectivity of the substance. In order to determine the respirability of a substance, a defined quantity of the powdery substance is blown into an artificial "lung" - a special test chamber with different levels - using a short, exactly dosed blast of compressed air (compressed air shot). Conclusions can be drawn on the repirability depending on the deposits of the substance in the levels of the test chamber. The prerequisite for the correct determination of respirability is the optimal and exact dosing of the compressed air. The testo 6440 compressed air counter, with its individually parameterizable signal outputs and its very fast reaction time, provides the ideal assistance for this and many other applications, in which a highly precise dosing of compressed air is essential.



3.1 Versions

Testo offers four compact models for the most common diameters in industry:

2.3 to 700 Nm³/h
testo 6444
(DN 50) (2")

1.3 to 410 Nm³/h
testo 6443
(DN 40) (1½")

0.75 to 225 Nm³/h
testo 6442
(DN 25) (1")

0.25 to 75 Nm³/h
testo 6441
(DN 15) (½")

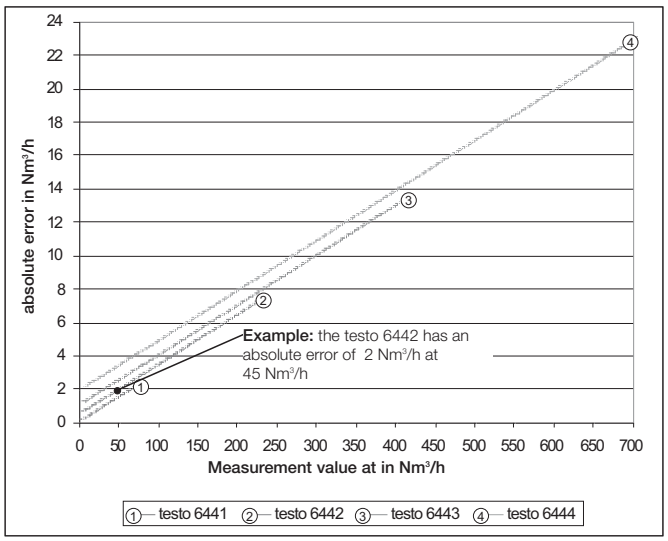
3.2 Technical Data

	testo 6441	testo 6442	testo 6443	testo 6444
Part no.	0555 6441	0555 6442	0555 6443	0555 6444
Pipe diameter	DN 15 (1/2")	DN 25 (1")	DN 40 (1 1/2")	DN 50 (2")
Measuring range (dynamics 1:300)	0.25 to 75 Nm³/h 4 to 1250 Nl/min	0.75 to 225 Nm³/h 1.3 to 3750 Nl/min	1.3 to 410 Nm³/h 22.2 to 6830 Nl/min	2.3 to 700 Nm³/h 0.04 to 11.67 Nm³/min
Max. display	0.0 to 90.0 Nm³/h 0 to 1500 Nl/min	0.0 to 270 Nm³/h 0 to 4500 Nl/min	0.0 to 492 Nm³/h 0 to 8200 Nl/min	0.0 to 840 Nm³/h 0 to 14 Nm³/min
Measuring pipe: Thread (both sides) / Material	R ½, external thread Stainless steel 1.4301	R1, external thread Stainless steel 1.4301	R1 ½, external thread Stainless steel 1.4401	R2, external thread Stainless steel 1.4401
Length measurement pipe	300 mm	475 mm	475 mm (shortened measurement pipes)	475 mm (shortened measurement pipes)
Weight	0.9 kg	1.1 kg	3.0 kg	3.8 kg

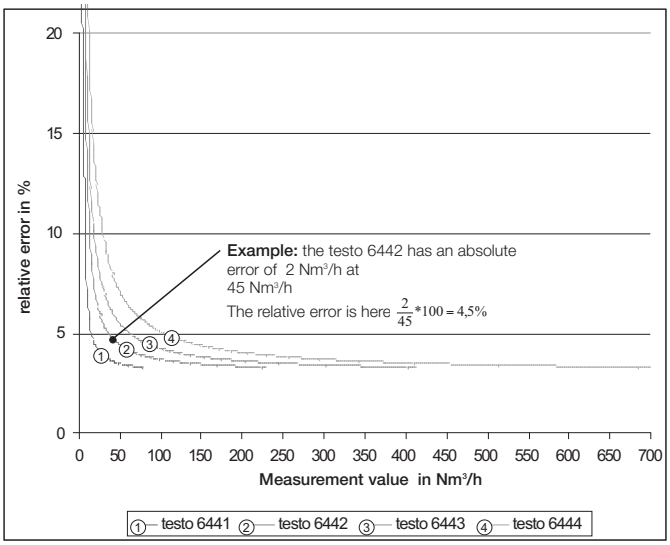
B 3.2 Technical data

Sensor	Thermal glass-coated ceramic sensor
Accuracy Inaccuracy contribution	for compressed air quality classes (ISO 8573: particles – humidity – oil) 1-4-1: ±3% of measurement value ±0,3% of final value for compressed air quality classes (ISO 8573: particles – humidity – oil) 3-4-4: ±6% of measurement value ±0,6% of final value

Absolute measurement inaccuracy flow-through sensor



Relative measurement inaccuracy flow-through sensor
(refers to the current measurement value)



Response time	< 0,1 sec (for damping parameter = 0), delayable via operating menu (0 s to 1 s)
Temperature display	0 to +60 °C (+32 to +140 °F), measurement error ±2K (usually only used as a plausibility check)
Display, operation	4-figure alphanumeric display, two operating buttons, operating menu, LED (4x green for phys. units, 3x yellow for “display x 1.000” or switch stati)
Display units	Nm³/h, Nl/min, Nm³, °C (selected unit displayed via green LED)
Electrical connection	M12x1-plug, load to 250 mA, short-circuit-proof (synchronized), reverse polarity-proof, overload-proof. Testo recommends the accessory cable order no. 0699 3393
Voltage supply	19 to 30 VDC, current consumption < 100 mA
Output signals	4 combinations can be parameterized via the operating menu, see chapter 2.5.1
Impulse output (see chap. 2.11.2)	Consumption counter (value available after reset or voltage loss due to permanent memory), value 0.001 to 1,000,000 m³, impulse length 0.02 s to 2 s, 24 VDC-Plevel
Analog output (see chap. 2.11.1)	4 to 20 mA (4-wire), max. load 500 Ohm, freely scalable between 0 to end of measuring range. Analog signal resolution: 12-Bit
Switch output (see chap. 2.11.3)	2 switch outputs, parameterizable (dependent on consumption or volume flow, time-dependent/independent, normally open/closed, hysteresis, window), loadable with max. 19 to 30 VDC or 250 mA each, switch status is displayed via 2 LEDs
Process conditions	0 to +60 °C (+32 to +140 °F), PN 16, (i.e. max. 16 bar absolute) rel. humidity < 90 %RH, air quality ISO 8573: recommended classes 1-4-1
Ambient temperature	0 to +60 °C (+32 to +140 °F)
Storage temperature	-25 to +85 °C (-15 to +185 °F)
Media contact	Materials stainless steel 1.4301 or 1.4401 (see above, Material), PEEK, polyester, viton, aluminium anodized, ceramics, silicon-free
Housing	PBT (GF 20%), zinc diecast, IP65 / III
EMC	According to guideline 89/336 EEC
Norm reference	Norm flow velocity (e.g. Nm/s) and norm volume flow (e.g. Nm³/h) refer to 15 °C / 1013.25 hPa/ 0 %RH (DIN ISO 2533)

4.1 Versions

Two models for the most common larger diameters in industry. They differ in their possibilities for exchanging the sensor under pressure.

testo 6446: Standard solution

testo 6447: With probe removal under pressure

Versions testo 6446	Part no.
DN 65 Galvanized steel measurement sensor:	0699 6446/1
DN 80 Galvanized steel measurement sensor:	0699 6446/2
DN 100 Galvanized steel measurement sensor:	0699 6446/3
DN 125 Galvanized steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/4
DN 150 Galvanized steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/5
DN 200 Galvanized steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/6
DN 250 Galvanized steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/7
DN 65 Stainless steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/11
DN 80 Stainless steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/12
DN 100 Stainless steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/13
DN 125 Stainless steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/14
DN 150 Stainless steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/15
DN 200 Stainless steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/16
DN 250 Stainless steel measurement sensor: PBCOmpac® SD48D-testo	0699 6446/17

Versions testo 6447	Bestell-Nr.
DN 65 Galvanized steel measurement sensor: replacement fitting WA 140®-2 SD48D-testo	0699 6447/1
DN 80 Galvanized steel measurement sensor: replacement fitting WA 140®-2 SD48D-testo	0699 6447/2
DN 100 Galvanized steel measurement sensor: replacement fitting WA 140®-2 SD48D-testo	0699 6447/3
DN 125 Galvanized steel measurement sensor: replacement fitting WA 140®-2 SD48D-testo	0699 6447/4
DN 150 Galvanized steel measurement sensor: replacement fitting WA 140®-2 SD48D-testo	0699 6447/5
DN 200 Galvanized steel measurement sensor: replacement fitting WA 140®-2 SD48D-testo	0699 6447/6
DN 250 Galvanized steel measurement sensor: replacement fitting WA 140®-2 SD48D-testo	0699 6447/7
DN 65 Stainless steel replacement fitting WA 140®-1 SD140D-testo	0699 6447/11
DN 80 Stainless steel Replacement fitting WA 140®-1 SD140D-testo	0699 6447/12
DN 100 Stainless steel replacement fitting WA 140®-1 SD140D-testo	0699 6447/13
DN 125 Stainless steel replacement fitting WA 140®-1 SD140D-testo	0699 6447/14
DN 150 Stainless steel replacement fitting WA 140®-1 SD140D-testo	0699 6447/15
DN 200 Stainless steel replacement fitting WA 140®-1 SD140D-testo	0699 6447/16
DN 250 Stainless steel replacement fitting WA 140®-1 SD140D-testo	0699 6447/17

- Each model is delivered including a standard ISO calibration certificate

- Versions for customer-specific diameters between DN 65 to DN 250 are available in stainless steel.

- Measurement pipes without electronic sensor assembly (DN 65 to DN 250) are available.

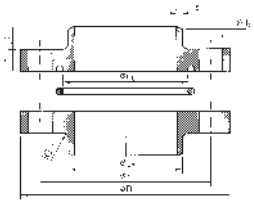
B 4 Compressed air counter testo 6446/6447 DN 65-250

4.2 Technical data

	testo 6446 & testo 6447						
Pipe diameter	DN 65 (2 ½)	DN 80 (3)	DN 100 (4)	DN 125 (5)	DN 150 (6)	DN 200 (8)	DN 250 (10)
Measuring range:	6.7 - 2000 Nm³/h	9.2 - 2750 Nm³/h	15 - 4440 Nm³/h	23 - 7000 Nm³/h	33 - 10000 Nm³/h	58 - 17500 Nm³/h	92 - 27500 Nm³/h
Max. display value:	0 - 2400 Nm³/h	0 - 3300 Nm³/h	0 - 5320 Nm³/h	0 - 8400 Nm³/h	0-12.0 (x 1000) Nm³/h	0-21.0 (x 1000) Nm³/h	0-33.0 (x 1000) Nm³/h
Length measurement pipe:	124 mm	160 mm	160 mm	172 mm	180 mm	180 mm	196 mm
Weight: testo 6447 testo 6446	9.3 kg 8.3 kg	11.6 kg 10.6 kg	13.7 kg 12.7 kg	21.6 kg 20.6 kg	26.4 kg 25.4 kg	37.0 kg 36.0 kg	49.4 kg 48.4 kg
Sensor:	Thermal glass-coatedceramic sensor						
Accuracy and application range:	For compressed air classes (ISO 8573: particles-humidity-oil) 1-4-1: ±3 % of measurement value ±0,3 % of final value For compressed air classes (ISO 8573: particles-humidity-oil) 3-4-4: ±6 % of measurement value ±0,6 % of final value						
Reaction time:	< 0.1sec						
Temperature display:	Not displayed						
Display, operation:	4-figure alphanumeric display two operating buttons, operating menu, LED (4 x green for physical units, 3 x yellow for "Display x 1.000" and switch stati						
Display units:	Nm³/min (Nl/min), Nm³/h, Nm³ (normed to15 °C / 1013.25 hPa / 0 %RH according to DIN ISO 2533)						
Electrical connection:	M12 x 1 plug, load up to 250 mA, short circuit-proof						
Voltage supply:	19 to 30 VDC, current consumption < 100 mA						
Output signals:	2 output signals, output types: analog signal, switch signal, pulse sequence for defined consumption quantity. Four combinations for the two outputs can be parameterized via the operating menu.						
Media	The instruments are adjusted to compressed air as standard. An adjustment to N2 or CO2 can be carried out at the works. This must be stated when ordering!						
Pulse/switch output:	DN 65 - DN 80 : 1 Imp./m³ DN 100 - DN 250 : 1 Imp./10m³						
Analog output:	4 to 20 mA, measurement range, max. load 500 Ohm						
Process conditions:	Up to 16 bar overload; 0 - +60 °C (rel. humidity max. 90%)						
Ambient temperature:	0 to +60 °C (32 to 140 °F)						
Storage temperature:	-25 to +85 °C (-13 to 185 °F)						
Media contact:	V2A (1.4301), glass-coated ceramics, PEEK, polyester, viton, anodized aluminium						
Housing:	PBT-GF 20, PC (APEC), Makrolon, V2A (1.4301), viton						
EMC:	According to guideline 89/336 EWG						
Norm reference:	Norm flow velocity (e.g. Nm/s) and norm volume flow (e.g. Nm3/h) refer 15 °C/1013.25hP/0 %RH (DIN ISO 2533)						

4.3 Compac welding flange DN 10-250 / PN 6-100

Pipe connection dimensions			Flange				Screws				Gasket
						Rim	Weight	Thread			
DN	PN	d1	D	b	k	s	(7.85kg/dm3)	n	d2	d0	
10	6 -100	17.20	62.00	10.00	44.00	1.80	0.20 kg	M10	4	11.00	23.39
15	6 -100	21.30	66.00	10.00	48.00	2.00	0.22 kg	M10	4	11.00	26.57
20	6 -100	26.90	71.00	10.00	53.00	2.30	0.25 kg	M10	4	11.00	31.35
25	6 -100	33.70	84.00	10.00	63.00	2.60	0.34 kg	M12	4	13.00	40.87
32	6 -100	42.40	93.00	10.00	72.00	2.60	0.41 kg	M12	4	13.00	47.22
40	6 -40	48.30	95.00	12.00	77.00	2.60	0.40 kg	M10	4	11.00	53.57
	64 -100	48.30	95.00	12.00	77.00	2.90	0.46 kg	M10	8	11.00	53.57
50	6 -40	60.30	112.00	12.00	91.00	2.90	0.55 kg	M12	4	13.00	66.27
	64 -100	60.30	112.00	12.00	91.00	3.20	0.61 kg	M12	8	13.00	66.27
65	6 -40	76.10	125.00	12.00	106.00	2.90	0.69 kg	M12	8	13.00	82.10
	64 -100	76.10	142.00	15.00	115.00	3.60	1.22 kg	M16	8	17.00	82.10
80	6 -40	88.90	141.00	15.00	118.00	3.20	1.09 kg	M12	8	13.00	94.80
	64 -100	88.90	154.00	15.00	124.00	4.00	1.38 kg	M16	8	17.00	94.80
100	6 -40	114.30	165.00	15.00	144.00	3.60	1.27 kg	M12	8	13.00	120.25
	64 -100	114.30	180.00	20.00	153.00	5.00	2.37 kg	M16	12	17.00	120.25
125	6 -16	139.70	205.00	18.00	178.00	4.00	2.49 kg	M16	8	17.00	145.63
	25 -100	139.70	220.00	21.00	187.00	6.30	3.73 kg	M20	8	21.00	145.63
150	6 -16	168.30	235.00	20.00	208.00	4.50	3.40 kg	M16	8	17.00	177.40
	25 -100	168.30	250.00	22.00	217.00	7.10	4.55 kg	M20	12	21.00	177.40
175	6 -100	193.70	275.00	24.00	242.00	8.00	5.75 kg	M20	12	21.00	196.22
200	6 -16	219.10	290.00	20.00	263.00	5.90	4.66 kg	M16	12	17.00	228.20
	25 -100	219.10	326.00	26.00	286.00	10.00	9.50 kg	M24	12	25.00	228.20
250	6 -16	273.00	355.00	24.00	321.00	6.30	7.85 kg	M16	12	17.00	228.20
	25 -100	273.00	380.00	34.00	340.00	12.00	15.22 kg	M24	16	25.00	278.99

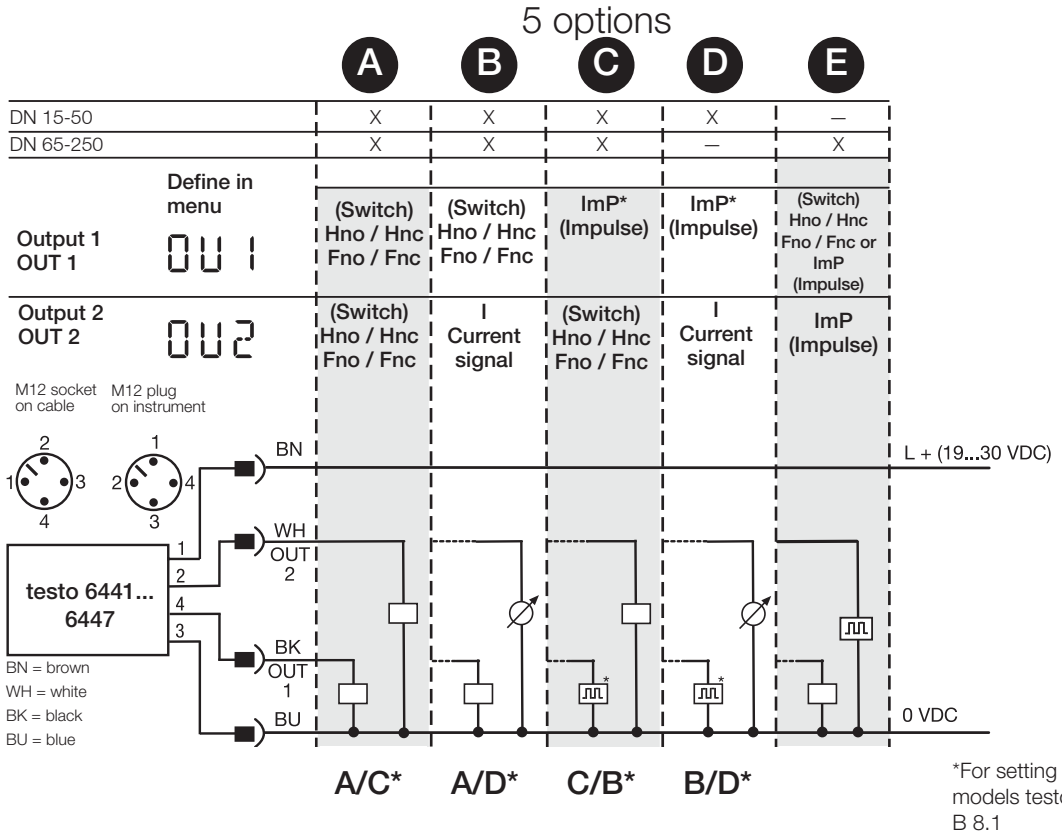


The instrument may only be installed by a qualified electrician. Observe the national and inernational regulations on the installation of electrotechnical systems. Supply voltage according to EN50178, SELV, PELV .

[testo 6446/6447 to]
In order to fulfil the “limited voltage” requirements in compliance with UL 508, the instrument must be supplied from a galvanically isolated source, and be protected by an overcurrent protection.

If you are using the optionally available 5-wire connection cable with potential-free pulse output (see accessories), proceed as described further down when connecting the electronic sensor assembly.

If you are connecting the electronic sensor assembly directly, or are using a 4-wire connection cable, please proceed as described below.



*For setting in instument menu in models testo 6441/6444 vgl. Kap. B 8.1

* If menu selection ImPR = Yes → pulse output
menu selection ImPR = No → switch output (pre-selection counter)

Terminal allocation	Core colours in cable 0699 3393
1 Supply connection 19 to 30 VDC (+)	brown
2 OUT 2 (Analog output (4 to20 mA) or switch output)	white
3 Supply connection0 V (-)	blue
4 OUT 1 (pulse output or switch output)	black

5.1 Potential isolation for testo 6446/6447

If you are using the optionally available connection cable for potention isolation (see accessories), the following wire allocation for the connection cable applies.

Pin no.	Core colour	Allocation
	Brown	+L (19 to30 V DC) voltage supply
	Pink	+ potential-free pulse output (collector) OUT1
	White	- potential-free pulse output (emitter) OUT1
	Green	OUT2
	Black	0 V DC (GND)

The potential-free pulse output OUT1 is specified as follows with this connection wire

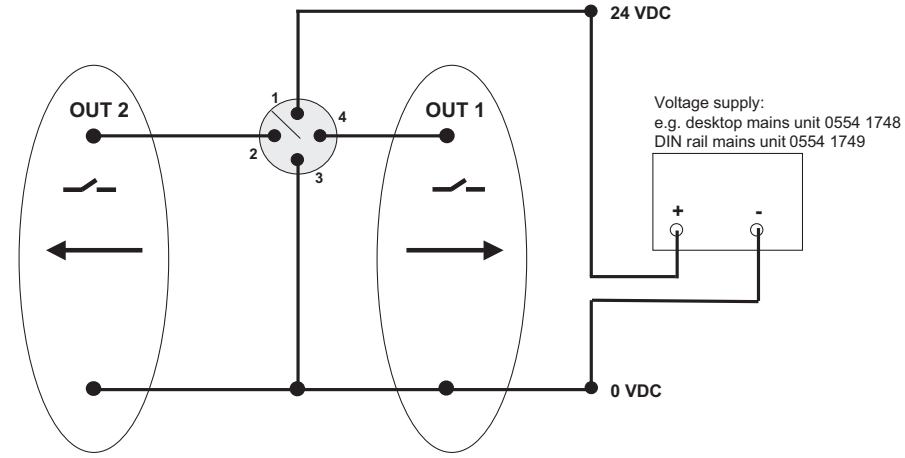
Type of cable	LiYCY
Length	5 m
Switching capacity	500 mA
Max. switching voltage	36 V
Min. switching voltage	5 V
Switch transition resistance	0.21 Ohm
Isolation voltage	5.3 kV
Reverse polarity-proof	Yes

B 5 Electrical connection

5.2 Wiring examples

Wiring testo 6441 ... 6447 alternative A
2 x switch output (cf. chap. 2.5)

OUT 1 (socket contact 4) as switch output
OUT 2 (socket contact 2) also parameterized as switch output

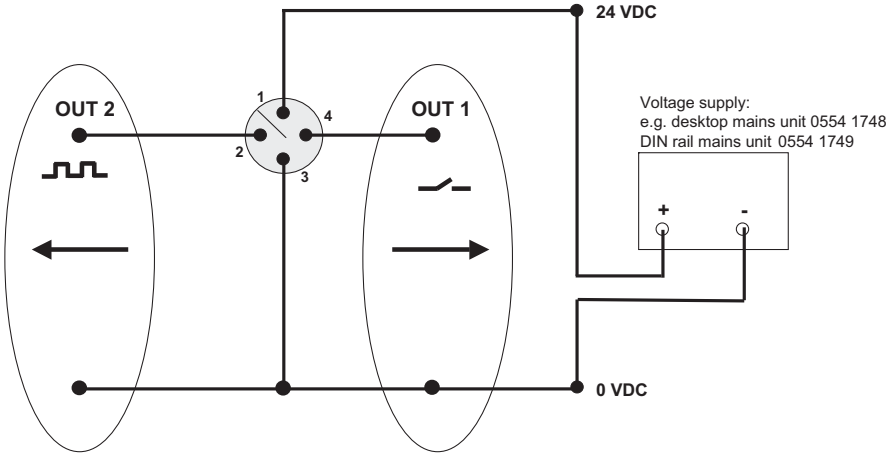


Switch output 2/3
- as digital input of a control
or
- for controlling an alarm lamp/horn

Switch output 4/3
- as digital input of a control
or
- for controlling an alarm lamp/horn

Wiring testo 6441...6447 alternative B
1 x switch and 1 x analog output (cf. chap. 2.5)

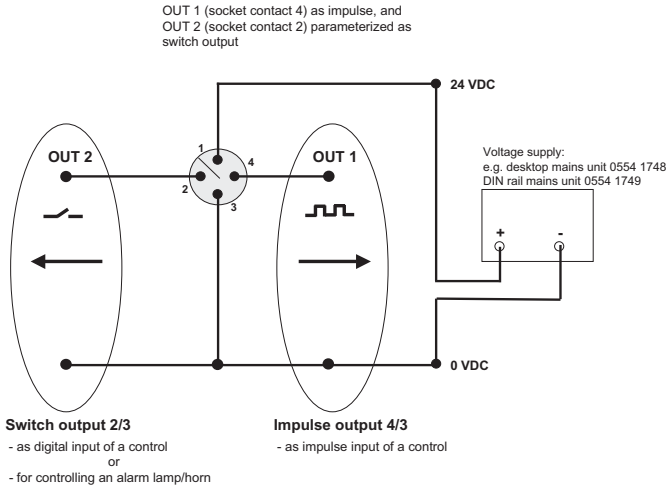
OUT 1 (socket contact 4) as switch, and
OUT 2 (socket contact 2) parameterized as analog output



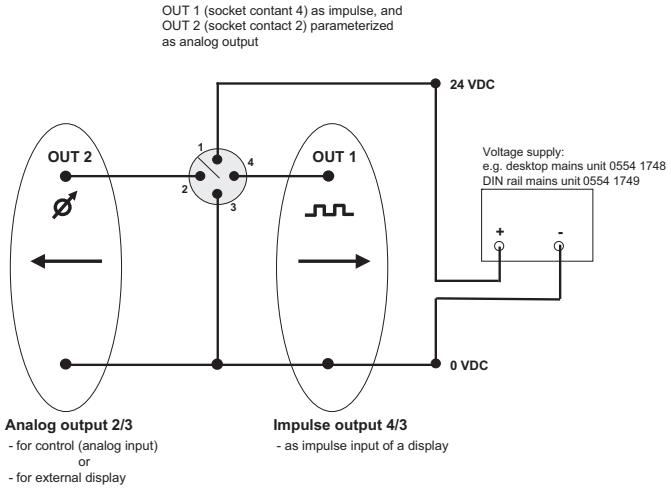
Switch output 2/3
- as impulse output of a control

Switch output 4/3
- as digital input of a control
or
- for controlling an alarm lamp/horn

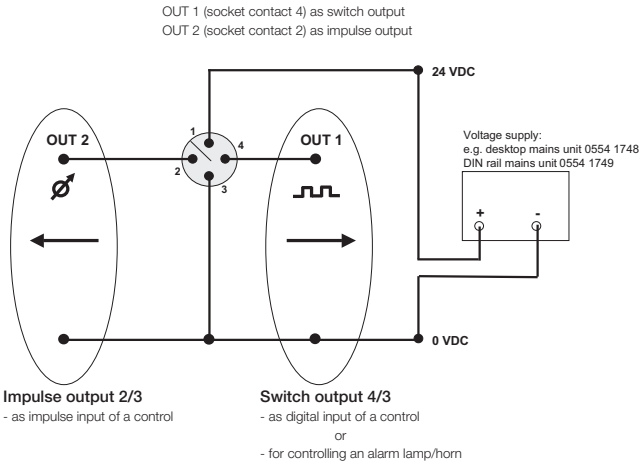
Wiring testo 6441...6447 alternative C
1 x impulse und 1 x switch output (cf. chap. B 5.1)



Wiring testo 6441...6444 alternative D
1 x impulse und 1 x analog output (cf. chap. B 5.1)

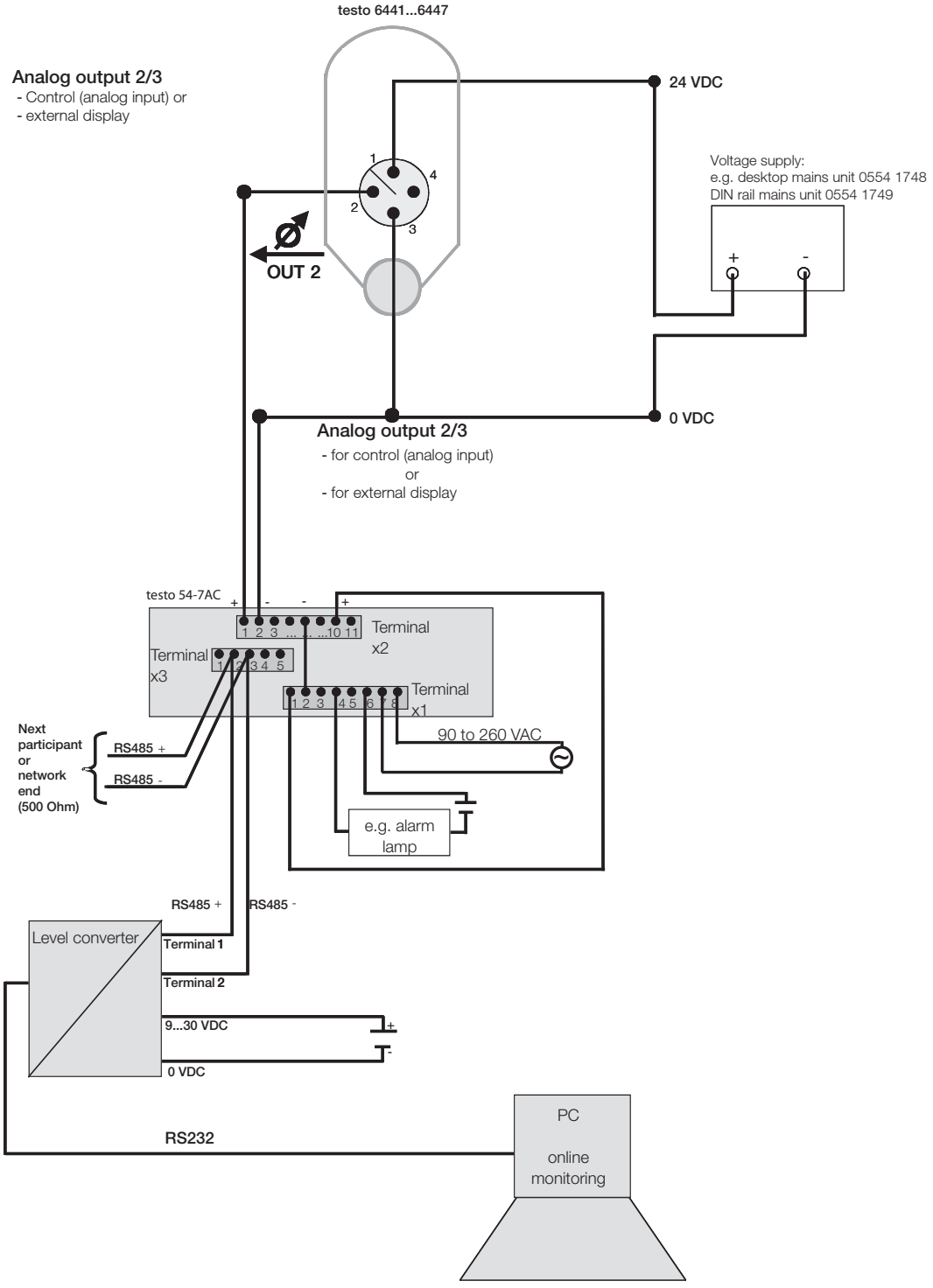


Wiring testo 6446...6447 alternative E
1 x switch und 1 x impulse output (cf. chap. B 5.1)



B 5 Electrical connection

testo 6441 ... 6447 (only analog output used here) with one process display testo 54-7 AC for using the relay outputs, the totalizer display and the RS485 output



Two of the following outputs are simultaneously available and can be parameterized in the operating menu (parameterization alternatives cf. chap. B 5.1):

- Analog output, 4 to 20 mA (4-wire), max. load 500 Ohm, freely scalable between 0 and end of measuring range.
- Impulse output, value and impulse length adjustable only in 6441...6444 :
  Value: 0.001 to1,000,000 Nm3
  Impulse length 0.02 to 2s, 24 VDC-level
  jeweils mit max. 19...30 VDC bzw. 250 mA belastbar

Signal outputs suited to the application

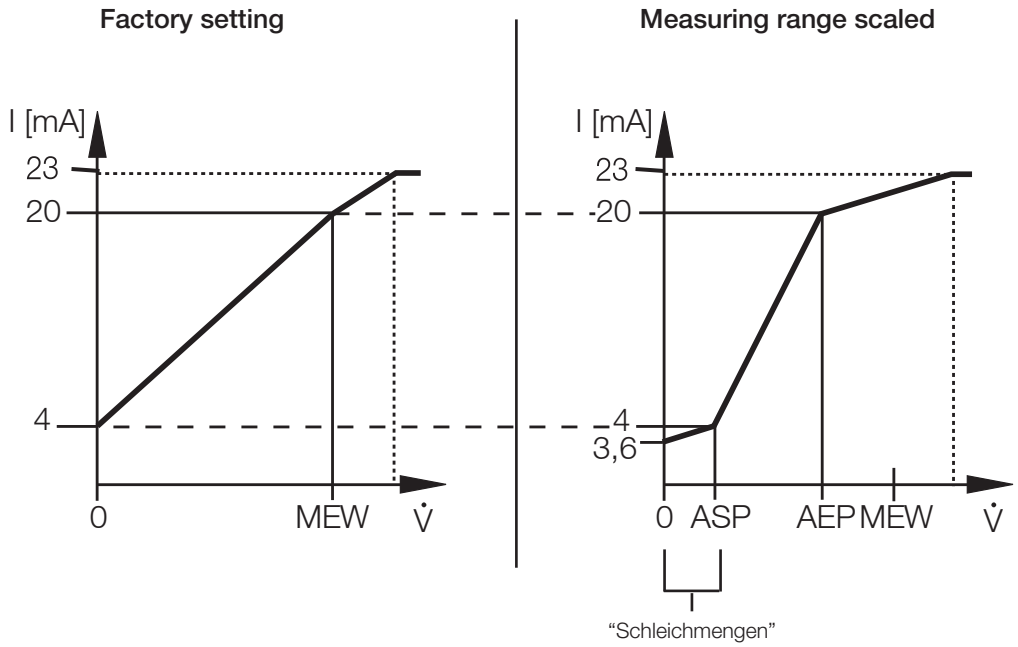
Application	1 Leakage detection	2 Consumption measurement	3 Peak load management	4 Min./max. monitoring	5 Dosing
	Nm³/h, t	Nm³, Nm³/h, Σ, t	Nm³/h, 0, 24 hours	Nm³/h, MAX, MIN, t	Nm³, Σ, Stop
Signal outputs	4 to 20 mA + limit value monitoring in PLC or *Switch output time-dependent (ON, if LV is reached before time T)	4 to 20 mA + Σ in SPS or Impulse + counting in PLC	4 to 20 mA	4 to 20 mA + limit value monitoring in PLC or 1 switch output MIN 1 switch output MAX (both time-dependent)	4 to 20 mA + Σ in PLC or Impulse + counting in PLC or *Switch output time-dependent (ON, as soon as LV reached)

*These signal outputs are available only for testo 6441...6444

6.1 Analog output setting

A 4 to 20mA output in 3-wire technology (terminal 2 = current signal, terminal 1 = supply L+, terminal 3 = common ground for current signal and supply.

In the operating menu, the variant "I" is first selected in the menu OU2. The analog start point (ASP) and the analog end point (AEP), i.e. at which measurement value the output signal should be 4 or 20 mA, can then be parameterized. In the set measuring range, the output signal is thus between 4 and 20 mA. If the through-flow is less than the set measuring range, the analog output signal is then between 3.6 mA and 4 mA, if it is greater than the set measuring range, the analog output signal is then between 20 mA and 23 mA.



Application: Leakage detection (limit value monitoring via PLC) or consumption quantity measurement (integration via PLC)

B 6 Signal outputs

6.2 Impulse output settings of the compressed air counter series

The impulse output of the testo 6440 can be used in two ways:

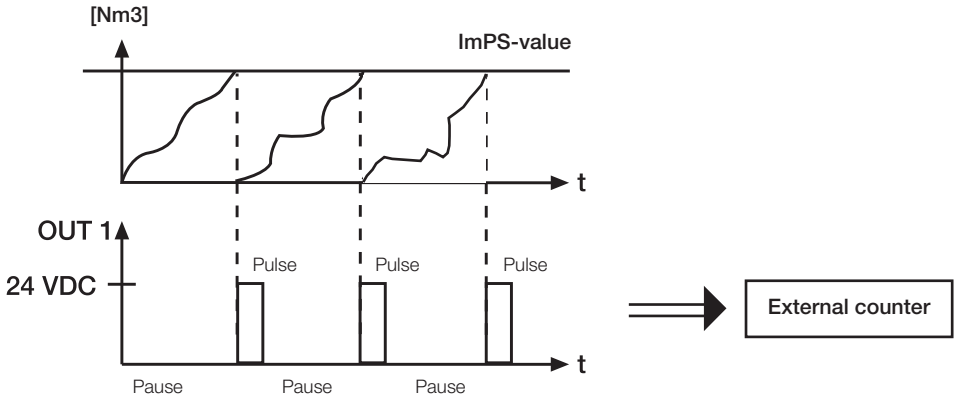
6.2.1. Counting impulses

When a defined quantity ImPS = impulse value [Nm³ / pulse] is reached, an impulse is sent.

This applies: $\frac{volume\ flow}{impulse\ value} = \frac{number\ of\ pulses}{hour}$

Beispiel: $\frac{250\ Nm^3/h}{25\ Nm^3/Impuls} = \frac{10\ Impulse}{h}$

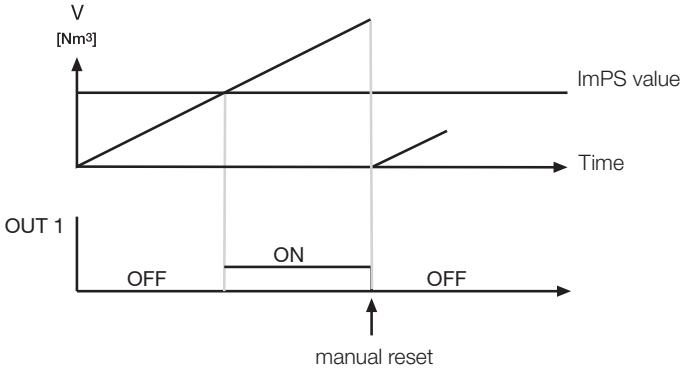
The pulse-pause ratio is at least 0.5. The pulse lasts between 0.02 and 2 sec (duration not parameterizable)



Application: Consumption quantity measurement

6.2.2 Pre-selection counter (for testo 6441...6444 only):

The output OUT 1 is switched through permanently when a defined quantity is reached, i.e. the impulse output is used as a consumption-dependent switch output.

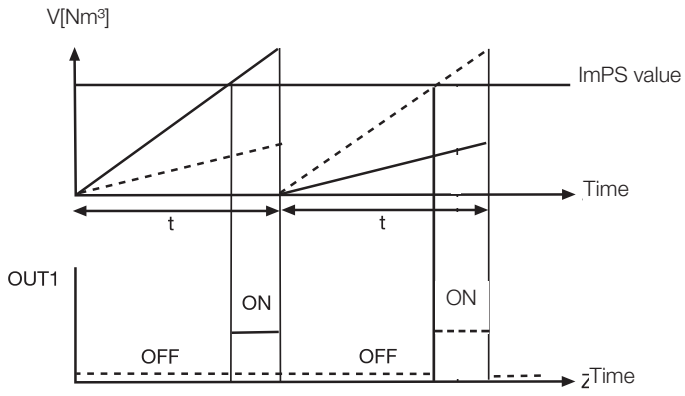


Here there are two possibilities again:

Time-independent quantity management

When a defined quantity (ImPS) is reached, the output OUT 1 is switched and remains switched on until a manual reset is made.

Application: Dosing



Time-dependent quantity monitoring

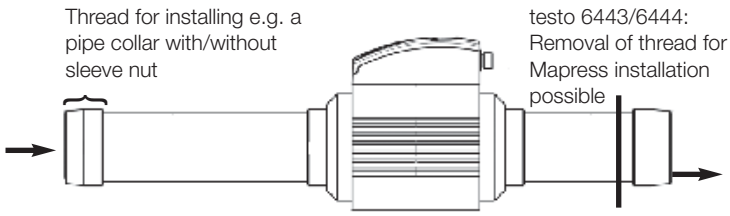
If the defined quantity (ImPS) is reached within a certain time duration t, the output OUT 1 is switched on. At the end of the time t or when a manual reset is made, the internal counter as well as the switch output OUT 1 are zeroed (OFF); the next time interval t begins.

Application: Leakage detection

7.1 Important installation information

General information

Before installation/drilling/welding, the system must be depressurized .



The compressed air counter may only be operated under the ambient conditions described in the technical data, otherwise measure inaccuracies can occur, and malfunction of the instrument cannot be ruled out

Please observe the detailed safety information in the instruction manual.

The installation site should be easily accessible, free of vibrations and should meet the ambient conditions in the technical data. Before the actual installation, the pipe must be depressurized. An installationspace of at least 300 mm must be guaranteed for the deinstallation of the sensor (in models > DN 65).

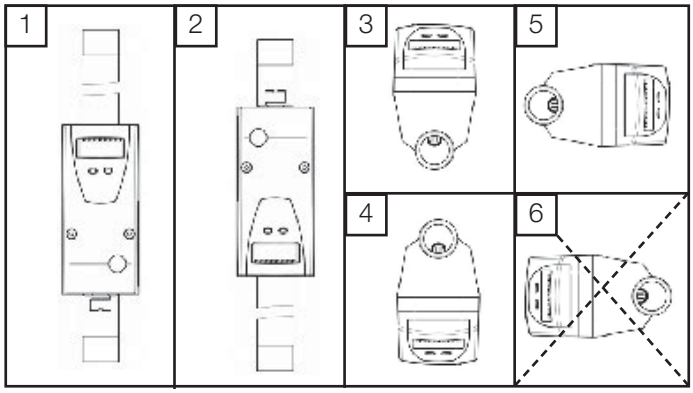
In the middle of the rating plate is a respiration filter which protects the interior of the housing from condensation. Please do not cover this up and protect it from damage.

Flow direction and installation position

The electronic sensor assembly can only be installed in one direction onto the replacement fitting. The head (display) of the electronic sensor assembly points in the direction of flow.

Installation position:

- Permitted installation positions: Measurement stretch vertical, any position (ill. 1, 2); measurement stretch horizontal, instrument vertical (ill. 3, 4), instrument lying laterally, measurement stretch left (ill. 5).
- Avoid the installation position ill. 6 (instrument lying laterally, measure ment stretch right). The respiration filter is here at the top, which is to be avoided.



Due to its ability to measure bidirectionally, testo 6441 ... 6447 can also be applied in ring lines. The actual flow direction is then detected by a seperate flow direction detector and transmitted to the PLC. Values can thus be added or subtracted in the PLC depending on their flow direction.

B 7 Installation

Inflow and outflow stretches

In order to obtain the specified measurement accuracy, the following installation requirements must be observed:

- defined inflow and outflow lengths (the inflow stretch describes the pipe length before the mass flow sensor, the outflow stretch the pipe length after the mass flow sensor, taken from the flow direction of the medium.)

- constant flow profile over time

For disturbances on the inflow side, additional straight stabilization pipes are recommended. These are minimum values. If the stabilization lengths are not observed, this has an effect on the measurement accuracy.

Inflow stretch + Outflow stretch = Total stretch			**6441**	**6442**	**6443**	**6444**	**6446**	**6447**	Additional stabilization stretch B
Inflow stretch	 B	90°-elbow	✔	✔	✔	✔	acc. to formulae*	acc. to formulae*	B = 5 x D**
	 B	two 90°-elbow, one level	✔	✔	+ 120 mm	+ 240 mm	acc. to formulae*	acc. to formulae*	B = 20 x D (6444 only) B = 10 x D**
	 B	two 90°-elbow two levels	+ 35 mm	+ 40 mm	+ 320 mm	+ 490 mm	acc. to formulae*	acc. to formulae*	B = 25 x D**
	 B	valve, slide valve	+ 360 mm	+ 590 mm	+ 1100 mm	+ 1500 mm	acc. to formulae*	acc. to formulae*	B = 35 x D**
Outflow stretch		the pipe section included is sufficient					acc. to formulae*		

* Formulae for the calculation of inflow and outflow stretches:
Inflow stretch = 15 x D** + B
Outflow stretch = 5 x D**

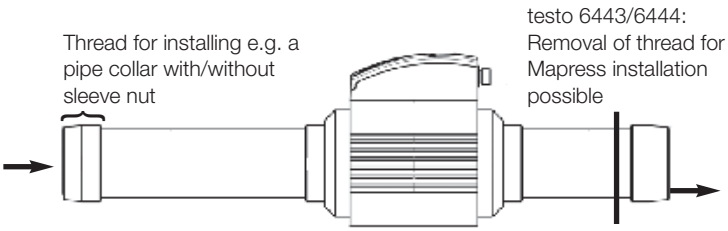
**D = Pipe diameter (inner)
✔ = testo 6440-measurement stretch sufficient

Positioning in the compressed air system

A preferred installation location for the testo 6441 ... 6447 is directly behind the compressed air dryer or close to the consumer, although installation after the maintenance unit is also possible. If oil is used for the consumer, the testo 6441 ... 6447 must be installed in front of the oiler, in order to avoid contamination of the sensor. In an operational compressed air network, the measurement site can only be behind a suitable compressed air dryer which provides for a suitable pressure dewpoint, otherwise the measurement accuracy cannot be guaranteed.

7.2 Installation testo 6441...6444 DN 15-DN 50

Observe the rules and regulations for the setting up and operation of compressed air systems.



Install the testo 6440 in such a way that the the flow direction and the marking arrow are pointing in the same direction.

7.3 Installation testo 6446/6447 DN 65-DN 250

7.3.1 Description PBCOmpac flange

The groove into which the gasket (O-ring) fits is designed in such a way that the installation screws can be tightened up to the complete contact with the surfaces.

When full contact is made with the surface, a clear resistance is felt, which indicates complete sealing and correct installation.

Slight scratches in flange surfaces, even around the groove, have no negative effect on the seal, as the gasket is pressed onto the surfaces with high pressure, and is therefore able to fill any scratches with gasket material.

The PBCOmpac flanges are intended for welded installation. For installation directly onto the plastic flanges already existing in the pipeline, the PBCOmpac flanges included in delivery are not required. The measurement body can be attached directly to the plastic flange.

7.3.2 Schweißverbindung zur Rohrleitung PBCOmpac-Flansch

a)In order to avoid a mixed weld onto the pipe, the material of the flange must be steel or stainless steel, corresponding to the pipe.

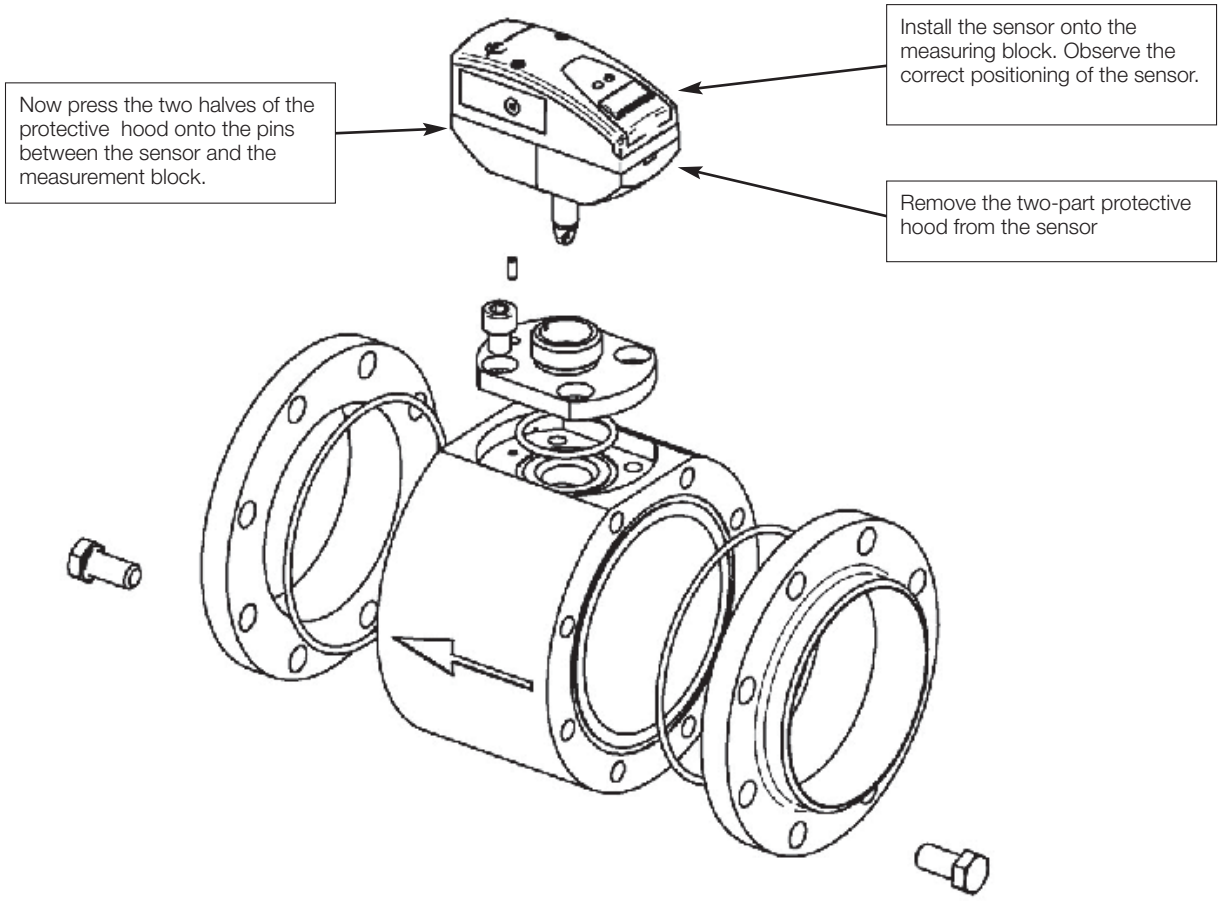
b)The inner diameters of the existing pipeline and the pipe section with the PBCOmpac flange must be identical! The corresponding model of compressed air counter must be selected.

c)COMPAC® flanges must welded without deformation, so that the seal achieved after installation is at an optimum level.

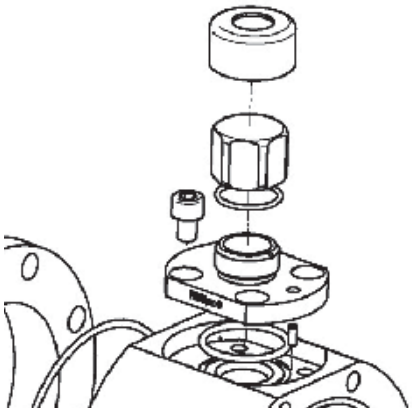
Remove the O-ring from the groove before welding! Before replacing the O-ring, ensure that the groove is clean. Clean the work area. After welding, clean the welds and ensure tha the pipe interior is smooth. A smooth transition from pipe to measuring block guarantees high accuracy.

B 7 Installation

7.3.3 Series 6446 (Standard)



Use of sealing cap (accessory)

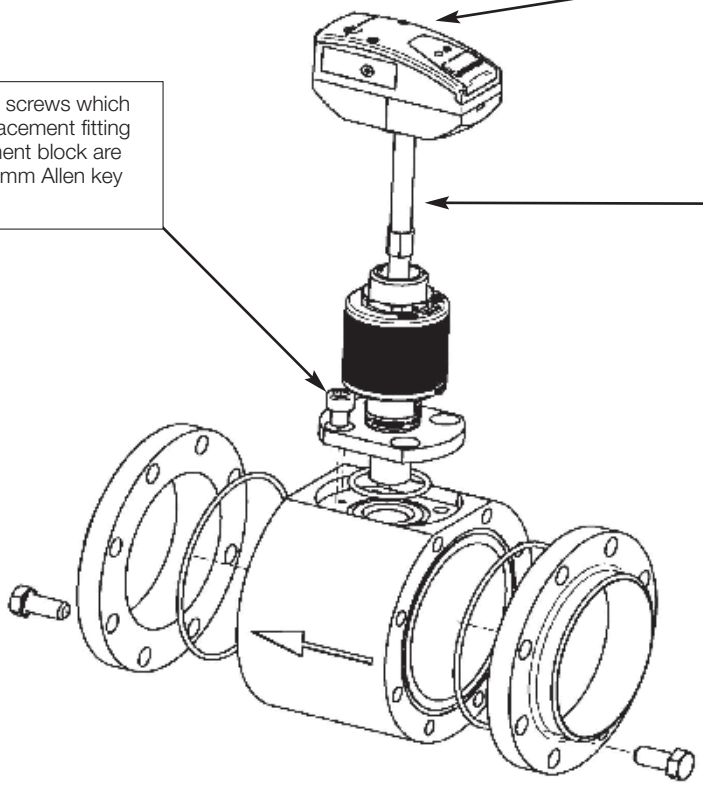


The sealing cap must be ordered as an accessory, it is not included in delivery.

If the optional sealing cap is installed, first ensure that the pipe is depressurized. Never remove the sealing cap from a pressurized pipe, this is extremely dangerous.

7.3.4 Series 6447 (with probe removal under pressure)

Installation of the electronic sensor assembly into the replacement fitting

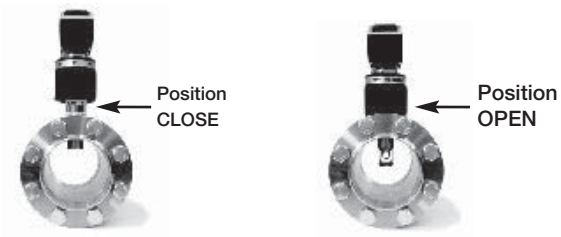


Due to the cylinder pin, electronic sensor assembly can be screwed into the replacement fitting in only one postion

A change of sensor [testo 6447 only] during operation is possible thanks to the replacement fitting without problems only if all necessary operating steps are taken.

Probe removal under pressure
The replacement fitting must be handled only by hand, not with tools. Do not damage the replacement fitting by using tools

Removing the electronic sensor assembly while the replacement fitting is in the position OPEN, i.e. screwed into the pipe, can cause danger to life.



Electronic sensor assembly in measurement position (OPEN)
A pre-condition is the correct insallation of the replacement fitting.

- Twist the replacement fitting only by hand, without tools, clockwise with the arrow direction OPEN slowly and steadily into the pipe.
- In order to guarantee the the specified measurement accuracy, the correct positioning of the sensor is important. For this reason, always screw the replacement fitting completely into the pipe.
- Never use tools or other objects in a manner for whichnthey are not intended on a replacement fitting or pressurized pipe.

Removing electronic sensor assembly (CLOSE)
A pre-condition is the correct insallation of the replacement fitting.

- Twist the replacement fitting only by hand, without tools, anti-clockwise with the arrow direction CLOSE slowly and steadily out of the pipe.
- Only when the replacement fitting is completely in the position CLOSE does the O-ring seal the electronic sensor assembly from the pressurized pipe.
- Slowly release the nut at the top of the replacement fitting. Allow the air to escape slowly, and ensure that it was only a brief pressure release, and that the replacement fitting is securely sealed.
- Remove the nut completely and rwemove the electronic sensor assembly by lifting it vertically out of the pipe.

Take care of the sensitive sensor tip, and use the protective cap for transport.

B 8 Operating element and operating menu of the testo 6441 ... 6447

One great advantage of the compressed air counter series testo 6440 is the practically designed display, which is easily legible even in machine halls, can be rotated by 180° and with which the display/operating menu can be locked.

The measuring instruments of the compressed air counter series testo 6440 have one display and two operating buttons "Mode/Enter" and "Set". These allow access to the operating menu, which offers, in addition to the changing of units and the parameterization of the signal outputs, many other useful functions.

SET

means: press SET-button briefly (increase value or scroll through)

SET

means: SET-button longer (change parameter or reset)

MODE

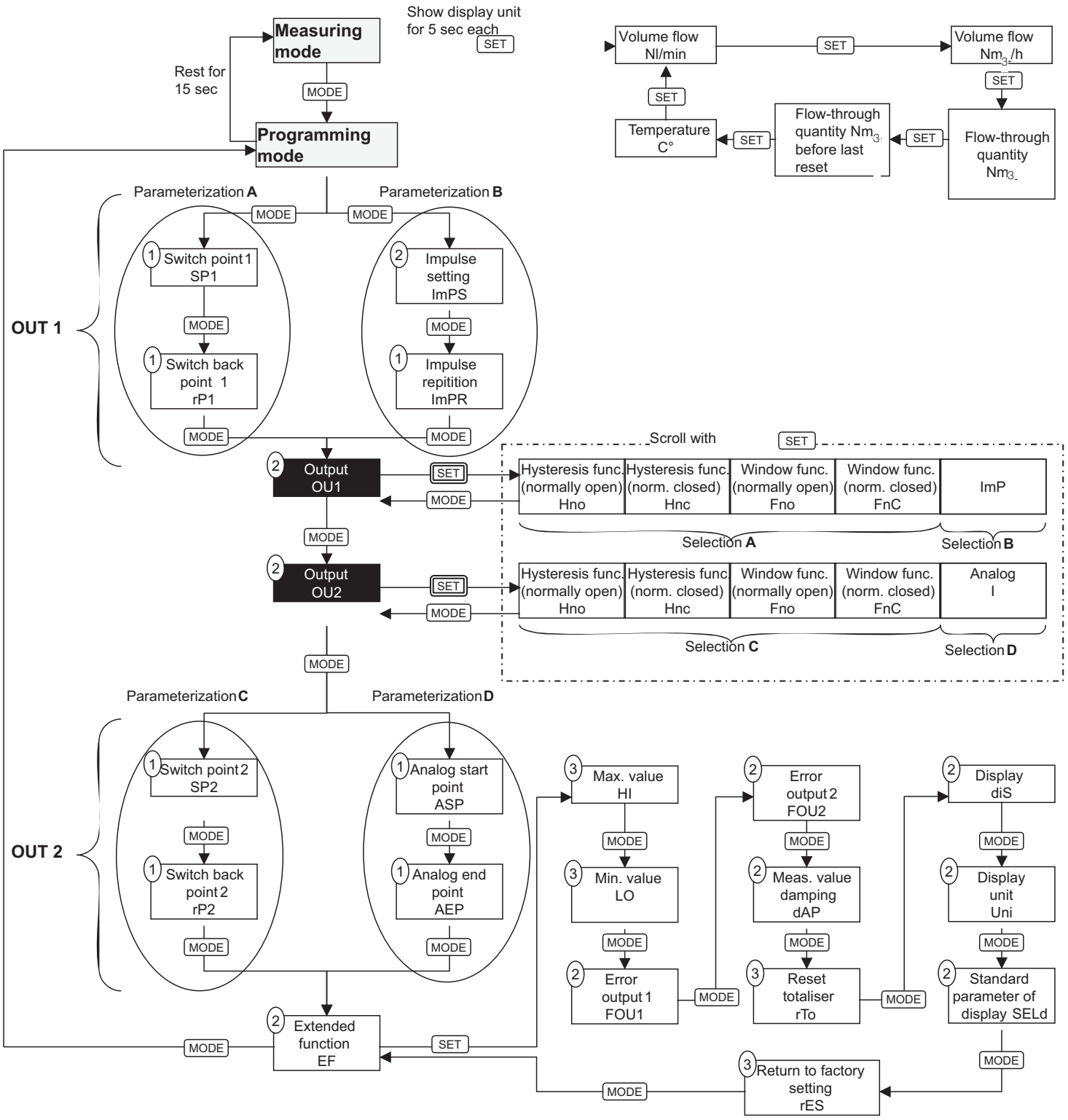
means: press MODE/ENTER-button (confirm setting)

Note:

- if no button is pressed for 15 s in programming mode, the testo 6440 returns to display mode
- button locking is activated or deactivated by pressing the SET- and MODE-buttons simultaneously (for 10 s)

A/B: variants for output OUT 1 (terminals 4/3) is allocated in the menu **OU1**

C/D: variants for output OUT 2 (terminals 2/3) is allocated in the menu **OU2**



There are **3 types of sub-menu** (handling of the operating buttons):

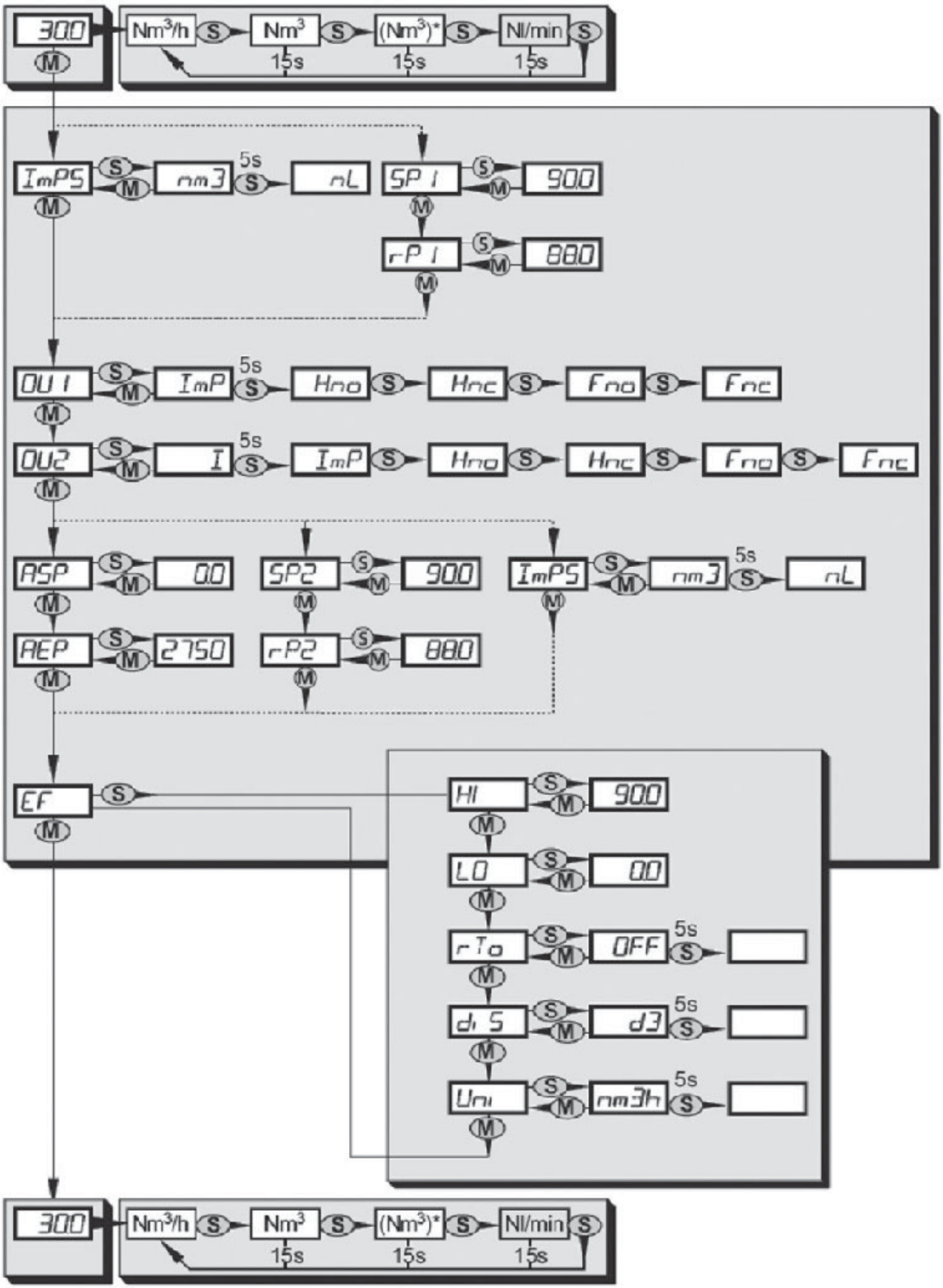
① Change parameters SET / increase value SET / scroll or confirm MODE

② Change parameters SET / scroll SET or MODE / confirm
next figure: figure changes automatically if SET is not pressed

③ Reset SET , i.e. reset to factory setting.

B 8 Operating element and menu of the testo 6441...6447

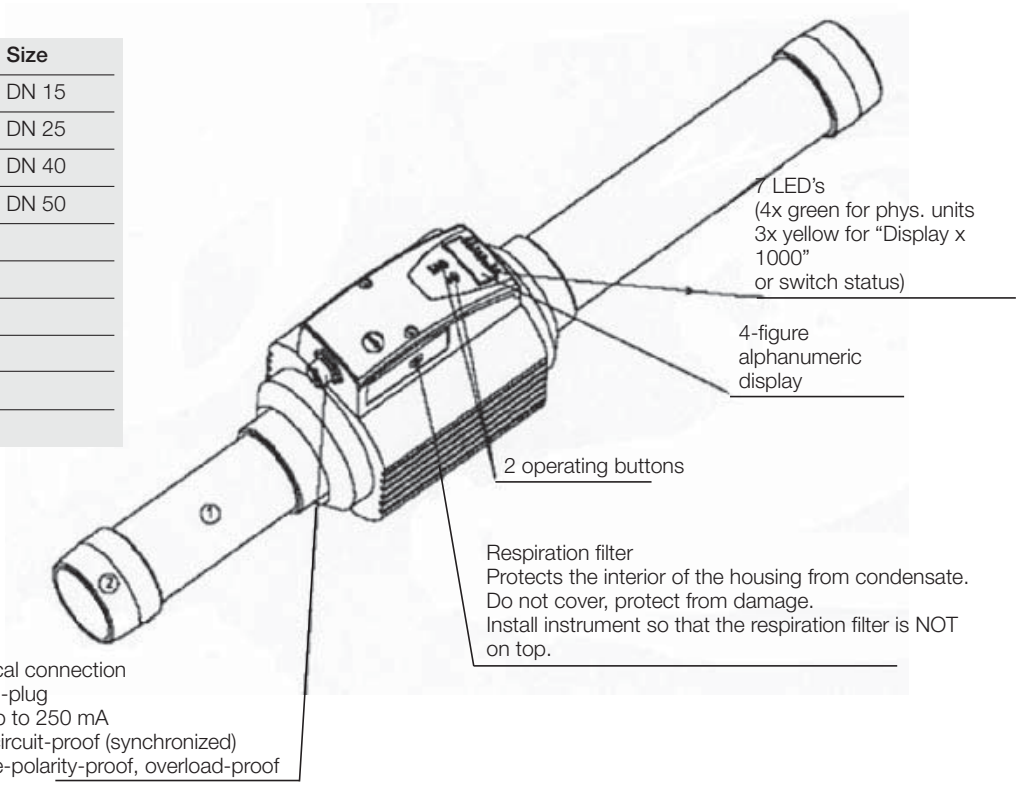
8.2 testo 6446/6447

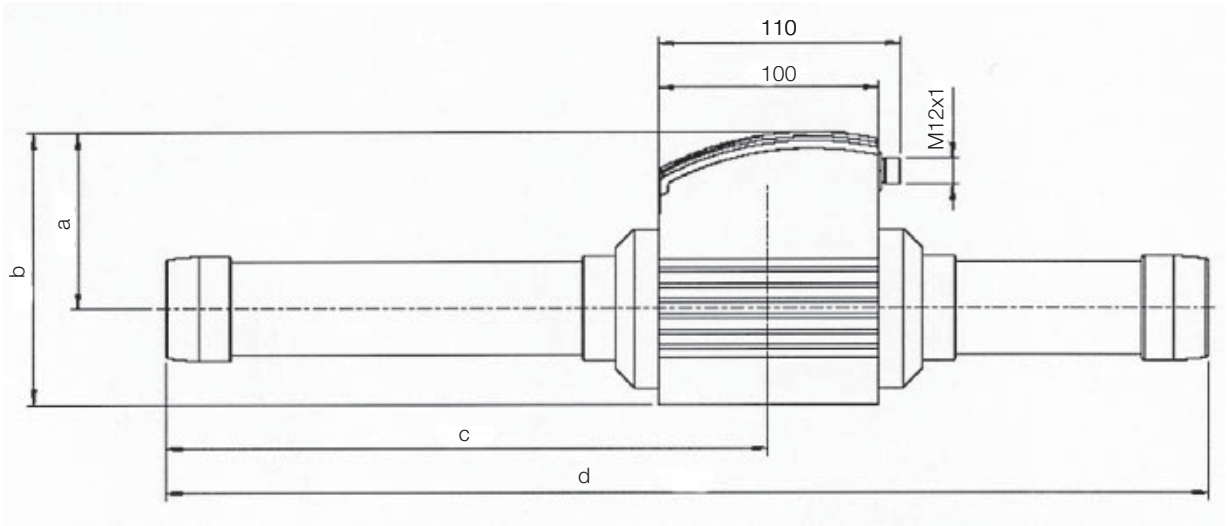


9.1 Technical drawings testo 6441...6444testo 6441...6444

Instrument	Material	Size
testo 6441	1.4301	DN 15
testo 6442	1.4301	DN 25
testo 6443	1.4401	DN 40
testo 6444	1.4401	DN 50

	Thread
testo 6441	R 1/2
testo 6442	R 1
testo 6443	R 1 1/2
testo 6444	R 2

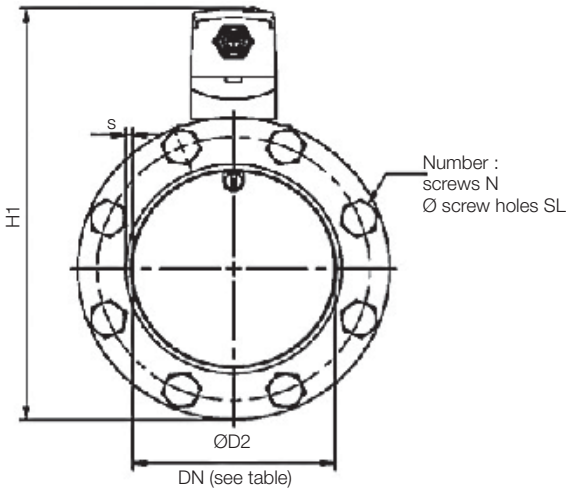


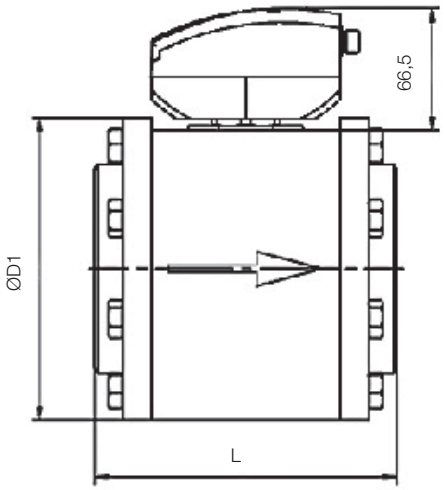


mm	6441	6442	6443	6444
a	-	-	80.2	86.2
b	80	91,7	135.3	135.3
c	210	375	275	275
d	300	475	475	475

B 9 Dimensions

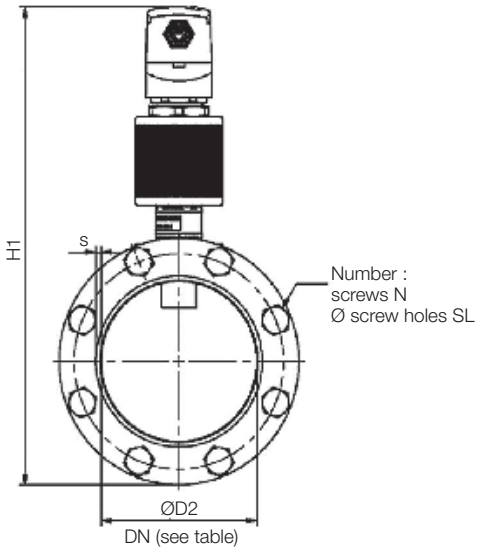
9.2 Technical drawings testo 6446

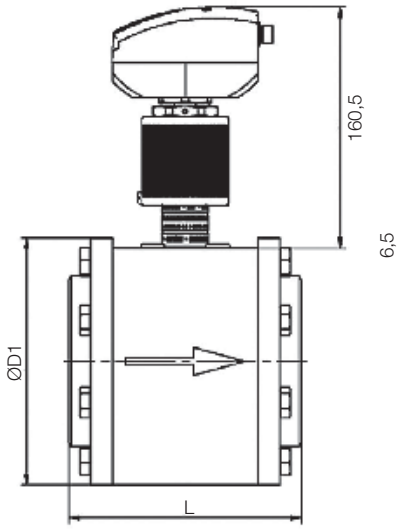




Nominal width	L (mm)	D1 (mm)	D2 (mm)	S (mm)	H1	N	SL	G1*(kg)
DN 65	124	125	70.3	2.9	185	8	13	8.3
DN 80	160	141	82.5	3.2	201	8	13	10.6
DN 100	160	165	107.1	3.6	225	8	13	12.7
DN 125	172	205	131.7	4	265	8	17	20,6
DN 150	180	235	159.3	4.5	295	8	17	25.4
DN 200	180	290	207.3	5.9	350	12	17	36.0
DN 250	196	355	260.4	6.3	415	12	21	48.4

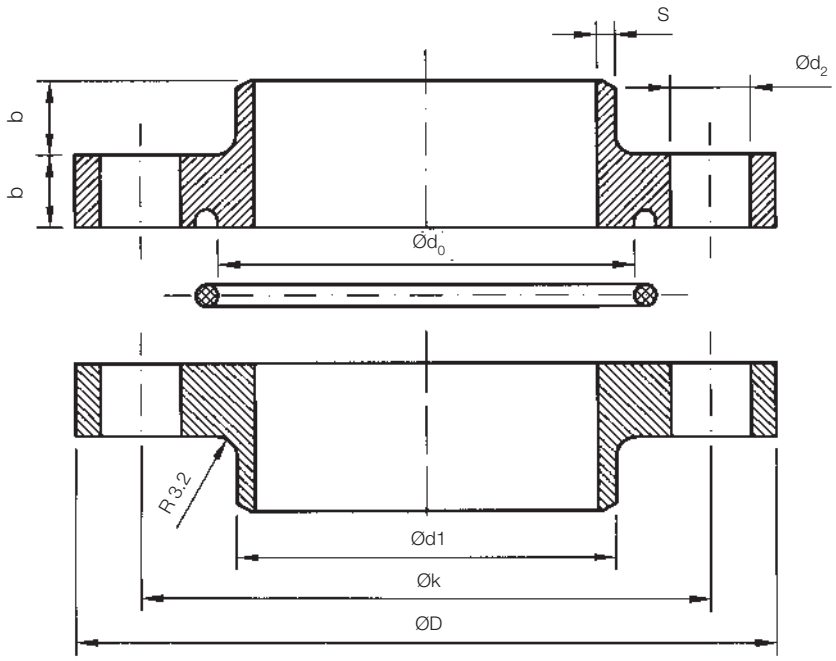
9.3 Technical drawings testo 6447





Nominal width	L (mm)	D1 (mm)	D2 (mm)	S (mm)	H1	N	SL	G1*(kg)
DN 65	124	125	70.3	2.9	279	8	13	9.3
DN 80	160	141	82.5	3.2	295	8	13	11.6
DN 100	160	165	107.1	3.6	319	8	13	13.7
DN 125	172	205	131.7	4	359	8	17	21.6
DN 150	180	235	159.3	4.5	389	8	17	26.4
DN 200	180	290	207.3	5.9	444	12	17	37.0
DN 250	196	355	260.4	6.3	509	12	21	49.4

9.4 Technical drawing of the welding flange for testo 6446/6447



Pipe connection dimensions)			Flange					Screws			Gasket
DN	PN)	d_1	D	b	k	Rim s	Weight (7.85 kg/dm³)	Thread	n	d_2	d_0
10	6-100	17.20	62.00	10.00	44.00	1.80	0.20 kg	M10	4	11.00	23.39
15	6 - 100	21.30	66.00	10.00	48.00	2.00	0.22 kg	M10	4	11.00	26.57
20	6 - 100	26.90	71.00	10.00	53.00	2.30	0.25 kg	M10	4	11.00	31.35
25	6 - 100	33.70	84.00	10.00	63.00	2.60	0.34 kg	M12	4	13.00	40.87
32	6 - 100	42.40	93.00	10.00	72.00	2.60	0.41 kg	M12	4	13.00	47.22
40	6 - 40	48.30	95.00	12.00	77.00	2.60	0.40 kg	M10	4	11.00	53.57
	64 - 100	48.30	95.00	12.00	77.00	2.90	0.46 kg	M10	8	11.00	53.57
50	6 - 40	60.30	112.00	12.00	91.00	2.90	0.55 kg	M12	4	13.00	66.27
	64 - 100	60.30	112.00	12.00	91.00	3.20	0.61 kg	M12	8	13.00	66.27
65	6 - 40	76.10	125.00	12.00	106.00	2.90	0.69 kg	M12	8	13.00	82.10
	64 - 100	76.10	142.00	15.00	115.00	3.60	1.22 kg	M16	8	17.00	82.10
80	6 - 40	88.90	141.00	15.00	118.00	3.20	1.09 kg	M12	8	13.00	94.80
	64 - 100	88.90	154.00	15.00	124.00	4.00	1.38 kg	M16	8	17.00	94.80
100	6 - 40	114.30	165.00	15.00	144.00	3.60	1.27 kg	M12	12	13.00	120.25
	64 - 100	114.30	180.00	20.00	153.00	5.00	2.37 kg	M16	8	17.00	120.25
125	6 - 16	139.70	205.00	18.00	178.00	4.00	2.49 kg	M16	8	17.00	145.63
	25 - 100	139.70	220.00	21.00	187.00	6.30	3.73 kg	M20	8	21.00	145.63
150	6 - 16	168.30	235.00	20.00	208.00	4.50	3.40 kg	M16	8	17.00	177.40
	25 - 100	168.30	250.00	22.00	217.00	7.10	4.55 kg	M20	12	21.00	177.40
175	6 - 100	193.70	275.00	24.00	242.00	8.00	5.75 kg	M20	12	21.00	196.22
200	6 - 16	219.10	290.00	20.00	263.00	5.90	4.66 kg	M16	12	17.00	228.20
	25 - 100	219.10	326.00	26.00	286.00	10.00	9.50 kg	M24	12	25.00	228.20
250	6 - 16	273.00	355.00	24.00	321.00	6.30	7.85 kg	M20	12	21.00	278.99
	25 - 100	273.00	380.00	34.00	340.00	12.00	15.22 kg	M24	16	25.00	278.99