9 Temperature sensors

A platinum resistance thermometer utilizes the fact that the precious metal platinum has a very well-defined correlation with its resistance and the temperature. The correlation between the resistance and the temperature is defined in the standard EN 60751 (DIN/IEC 751). On MULTICAL® 303, Pt500 temperature sensors are used if the nominal ohmic resistance is 500,000 Ω at 0,00 °C and 692,528 Ω at 100,00 °C.

The correlation between the resistance R_t and the temperature t is defined by:

$$R_t = R_0(1 + At + Bt^2)$$

where R_0 indicates the resistance at 0,00 °C, whereas A and B are constants. The values R_0, A and B are determined by the verification of temperature sensor that is performed according to EN 1434-5.

In a heat or cooling meter, a temperature sensor set is used for measuring the temperature difference between inlet and outlet. Each of the two temperature sensors has its own values for R_0, A and B and thus, the requirement for an approved temperature sensor set, according to EN 1434-1, is that the maximum difference in percent between the two temperature sensors, E_t, in the entire approval area must be maximum:

$$E_t = \pm\left(0{,}5 + 3\frac{\Delta\theta_{min}}{\Delta\theta}\right)$$

where Δθ is the specific temperature difference and $\Delta\theta_{min}$ is the minimum approved temperature difference, normally 3 degrees. The values R_0, A and B of the individual temperature sensors as well as E_t appear from the certificate of the temperature sensor set.

The table below shows the resistance values in [Ω] for each degree Celsius for Pt500 temperature sensors:

Pt500										
°C	0	1	2	3	4	5	6	7	8	9
0	500,000	501,954	503,907	505,860	507,812	509,764	511,715	513,665	515,615	517,564
10	519,513	521,461	523,408	525,355	527,302	529,247	531,192	533,137	535,081	537,025
20	538,968	540,910	542,852	544,793	546,733	548,673	550,613	552,552	554,490	556,428
30	558,365	560,301	562,237	564,173	566,107	568,042	569,975	571,908	573,841	575,773
40	577,704	579,635	581,565	583,495	585,424	587,352	589,280	591,207	593,134	595,060
50	596,986	598,911	600,835	602,759	604,682	606,605	608,527	610,448	612,369	614,290
60	616,210	618,129	620,047	621,965	623,883	625,800	627,716	629,632	631,547	633,462
70	635,376	637,289	639,202	641,114	643,026	644,937	646,848	648,758	650,667	652,576
80	654,484	656,392	658,299	660,205	662,111	664,017	665,921	667,826	669,729	671,632
90	673,535	675,437	677,338	679,239	681,139	683,038	684,937	686,836	688,734	690,631
100	692,528	694,424	696,319	698,214	700,108	702,002	703,896	705,788	707,680	709,572
110	711,463	713,353	715,243	717,132	719,021	720,909	722,796	724,683	726,569	728,455
120	730,340	732,225	734,109	735,992	737,875	739,757	741,639	743,520	745,400	747,280
130	749,160	751,038	752,917	754,794	756,671	758,548	760,424	762,299	764,174	766,048
140	767,922	769,795	771,667	773,539	775,410	777,281	779,151	781,020	782,889	784,758
150	786,626	788,493	790,360	792,226	794,091	795,956	797,820	799,684	801,547	803,410
160	805,272	807,133	808,994	810,855	812,714	814,574	816,432	818,290	820,148	822,004
170	823,861	825,716	827,571	829,426	831,280	833,133	834,986	836,838	838,690	840,541
180	842,392	844,241	846,091	847,940	849,788	851,635	-	-	-	-

Pt500, IEC 751 Amendment 2-1995-07

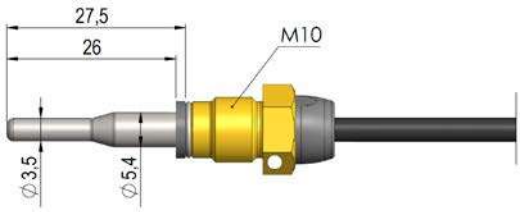
Table 5

9.1 Temperature sensor types

MULTICAL® 303 is delivered with TemperatureSensor 63. The required temperature sensor set is selected through the meter's type number. The table below shows the available temperature sensor sets. See the meter's complete type number in paragraph 3.1.

Sensor set (Pt500)	Length [mm]	Diameter Ø [mm]	Cable length [m]	
DS 27,5 mm direct short temperature sensor set	27,5	-	1,5	51
DS 27,5 mm direct short temperature sensor set	27,5	-	3,0	52
Ø5,0 mm direct temperature sensor set	-	5,0	1,5	61
Ø5,0 mm direct temperature sensor set	-	5,0	3,0	62
Ø5,2 mm direct temperature sensor set	-	5,2	1,5	71
Ø5,2 mm direct temperature sensor set	-	5,2	3,0	72

9.2 DS 27,5 mm direct short temperature sensor



Kamstrup TemperatureSensor 63 direct short DS 27,5 mm temperature sensor has been designed according to the European standard for heat energy meters EN 1434-2. The sensor is constructed to be mounted directly in the measuring medium, i.e. without sensor pocket, by which you obtain an extremely fast response to temperature changes from, for example, domestic water exchangers. The temperature sensor tube has a diameter of Ø3,5, is made of stainless steel and the temperature sensor element itself is placed in the tube. The temperature sensor is approved for both PN16 and PN25 installations, with PS25 as the maximum pressure. The sensor is based on two-wire silicone cable and can thus be used at medium temperatures up to 150 °C. One temperature sensor is mounted in the flow sensor from the factory and thus, only the other temperature sensor must be mounted. As shown in *Figure 15* and *Figure 16*, this can mounted by means of, for example, a nipple or a ball valve.

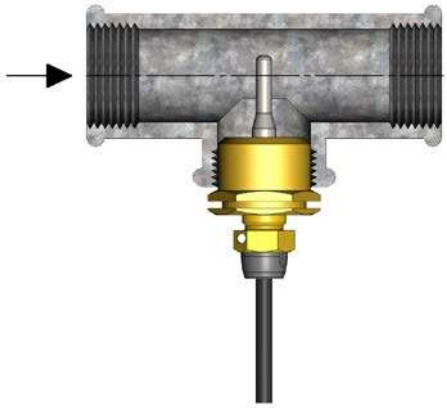


Figure 15

As shown in *Figure 15*, the DS 27,5 mm direct short temperature sensor can be mounted by means of an R½ or R¾ for M10 nipple in a standard 90° tee.

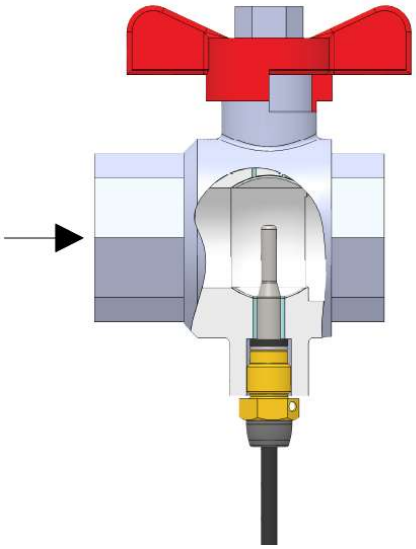


Figure 16

To obtain the best possible serviceability during meter exchange, the direct short temperature sensor can be placed in a ball valve with sensor socket, see *Figure 16*.

Ball valves with sensor socket are available in G½ and G¾, which both fit the DS 27,5 mm temperature sensor.

No.	6556-474	6556-475
	G½	G¾

9.3 Ø5,0 mm /Ø5,2 mm temperature sensors

Both Ø5,0 mm and Ø5,2 mm temperature sensors are delivered with mounted composite unions and this is why they by default must be used as direct temperature sensor. The composite unions can be removed (see paragraph 9.3.2) after which the temperature sensors can be used for installation in pockets. The temperature sensors are made from stainless steel and have diameters of Ø5,0 mm or Ø5,2 mm. The temperature sensors are approved for both PN16 and PN25 installations, with PS25 as the maximum pressure. The temperature sensors are based on a 2-wire silicone cable and can thus be used at media temperatures up to 150 °C. This also applies to the composite union that is made from the material PPS. One of the temperature sensors is mounted in the flow sensor from the factory and thus, only the other temperature sensor must be mounted if you choose to mount both temperature sensors as direct temperature sensors. The use of asymmetric sensor installation (one temperature sensor installed as a direct temperature sensor and the other as a pocket sensor) may only be performed when national regulations allow this and never in installations with low differential temperature and/or low water flow.

9.3.1 Installation of Ø5,0 mm / Ø5,2 mm temperature sensors as direct temperature sensors

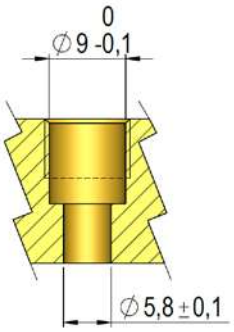
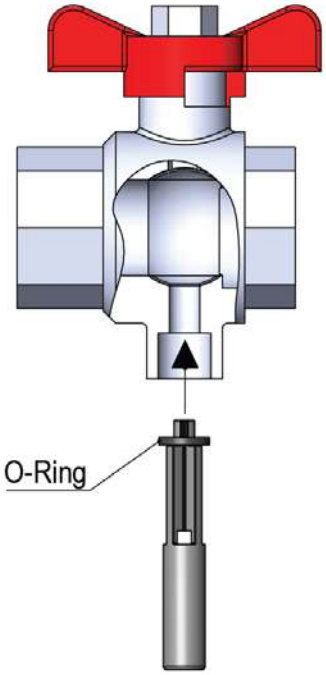
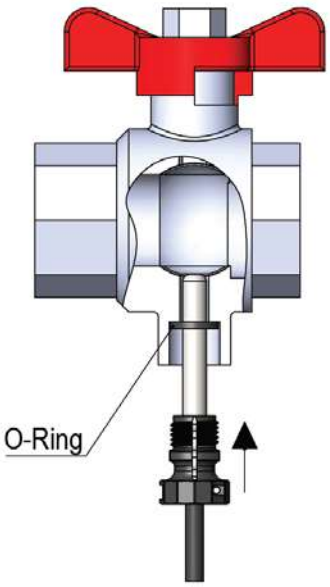


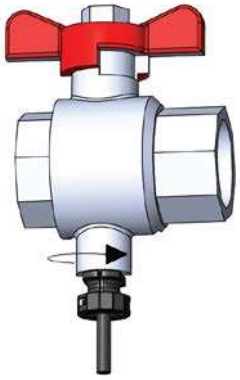
Figure 17: *Measurement and tolerance requirements at installation of direct Ø5,0 mm or Ø5,2 mm temperature sensor.*

No matter where the direct Ø5,0 mm or Ø5,2 mm temperature sensor is installed, it is very important to observe the tolerances stated in *Figure 17*. If not, the O-ring may not provide correct sealing. To avoid damaging the O-ring at installation, it is important to use the provided guide when installing Ø5,0 mm or Ø5,2 mm temperature sensors as direct temperature sensors.





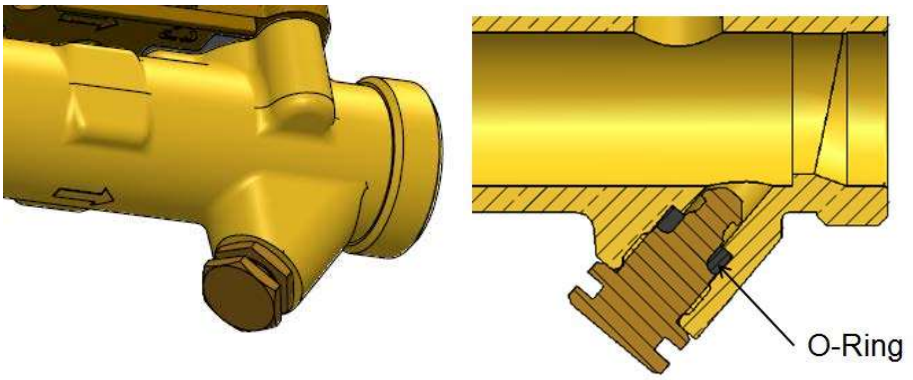
The O-ring guide is used for pushing the O-ring into place after which the temperature sensor can be pushed to the bottom.



The composite union is tightened by hand. Do not use any tools.

9.3.2 Installation of Ø5,0 mm / Ø5,2 mm temperature sensors as pocket sensors

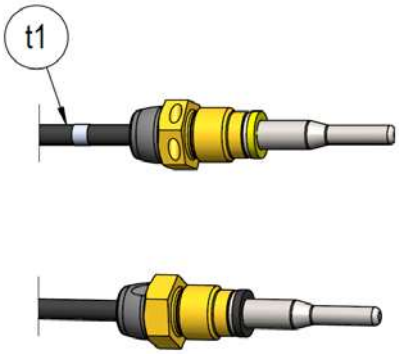
If you want to use Ø5,0 mm or Ø5,2 mm temperature sensors as pocket sensors, first remove the temperature sensor that is mounted in the sensor connecting pipe of the flow sensor. Please make sure that the O-ring of the temperature sensor O-ring is also removed. As shown in the illustration below, a blind plug is then mounted (with O-ring) in the sensor connecting pipe.



Then, the composite unions are removed from both temperature sensors by hand as shown in the following figure.

The temperature sensors can then be installed in sensor pockets.

9.4 Identification of inlet and outlet temperature sensors



To make it easier to perform a correct installation, the inlet temperature sensor has been added with additional two white markings on the cable, enabling you to easily identify which of the two temperature sensors are inlet and outlet temperature sensors, respectively. The white marking is placed right after the temperature sensor itself, see the figure above, and makes it easy to check that the inlet temperature sensor is installed in the inlet pipe. The other white marking is placed at the end of the cable, see the figure below, and in connection with reverification, it can be used for checking that the temperature sensors are subsequently correctly mounted in the calculator. Identification of inlet and outlet temperature sensors can likewise be seen on the label attached to the temperature sensors.