

Thermocouple Model TC10-B, for additional thermowell

WIKA data sheet TE 65.02



Applications

- Machine building, plant and vessel construction
- Energy and power plant technology
- Chemical industry
- Food and beverage industry
- Sanitary, heating and air-conditioning technology

Special features

- Application ranges from 0 ... +1200 °C
- For mounting in all standard thermowell designs
- Spring-loaded measuring insert (replaceable)
- Explosion-protected versions Ex-i, Ex-n and NAMUR NE24

Description

Thermocouples in this series can be combined with a large number of thermowell designs. Operation without thermowell is only recommended in certain applications.

A wide variety of possible combinations of sensor, connection head, insertion length, neck length, connection to thermowell etc. are available for the thermometers; suitable for any thermowell dimension and any application.

Optionally we can fit analogue or digital transmitters from the WIKA range into the connection head of the TC10-B.



Thermocouple for additional thermowell, model TC10-B

Sensor

Sensor type

Model	Recommended max. operating temperature
K (NiCr-Ni)	1200 °C
J (Fe-CuNi)	800 °C
E (NiCr-CuNi)	800 °C
T (Cu-CuNi)	400 °C
N (NiCrSi-NiSi)	1200 °C

The actual application range of these thermometers is limited both by the permissible max. temperature of the thermocouple and the sheath material as well as by the permissible max. temperature of the thermowell material.

Listed thermocouples are available both as single or dual thermocouples. The thermocouple will be delivered with an insulated measuring point, unless explicitly specified otherwise.

Tolerance value

A cold junction temperature of 0 °C is taken as basis with the definition of the tolerance value of thermocouples.

Type K

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +375 °C	± 1.5 °C
1	+375 ... +1000 °C	± 0.0040 · t ¹⁾
2	-40 ... +333 °C	± 2.5 °C
2	+333 ... +1200 °C	± 0.0075 · t ¹⁾
ISA (ANSI) MC96.1-1982		
Standard	0 ... +750 °C	± 2.2 °C or ²⁾ ± 0.75 %
Special	0 ... +750 °C	± 1.1 °C or ²⁾ ± 0.4 %

Type J

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +375 °C	± 1.5 °C
1	+375 ... +750 °C	± 0.0040 · t ¹⁾
2	-40 ... +333 °C	± 2.5 °C
2	+333 ... +750 °C	± 0.0075 · t ¹⁾
ISA (ANSI) MC96.1-1982		
Standard	0 ... +750 °C	± 2.2 °C or ²⁾ ± 0.75 %
Special	0 ... +750 °C	± 1.1 °C or ²⁾ ± 0.4 %

Type E

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +375 °C	± 1.5 °C
1	+375 ... +800 °C	± 0.0040 · t ¹⁾
2	-40 ... +333 °C	± 2.5 °C
2	+333 ... +900 °C	± 0.0075 · t ¹⁾

Type T

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +125 °C	± 0.5 °C
1	+125 ... +350 °C	± 0.0040 · t ¹⁾
2	-40 ... +133 °C	± 1.0 °C
2	+133 ... +350 °C	± 0.0075 · t ¹⁾

Type N

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +375 °C	± 1.5 °C
1	+375 ... +1000 °C	± 0.0040 · t ¹⁾
2	-40 ... +333 °C	± 2.5 °C
2	+333 ... +1200 °C	± 0.0075 · t ¹⁾

1) |t| is the value of the temperature in °C irrespective of the sign.
2) Whichever is the greater

Limited error with selected temperatures in °C for thermocouples type K and type J

Temperature (ITS 90) °C	Tolerance value DIN EN 60584 part 2	
	Class 1 °C	Class 2 °C
0	± 1.5	± 2.50
100	± 1.5	± 2.50
200	± 1.5	± 2.50
300	± 1.5	± 2.50
400	± 1.6	± 3.00
500	± 2.0	± 3.75
600	± 2.4	± 4.50
700	± 2.8	± 5.25
800	± 3.2	± 6.00
900	± 3.6	± 6.75
1000	± 4.0	± 7.50
1100	± 4.4	± 8.25
1200	± 4.8	± 9.00

Potential measuring uncertainties due to ageing effects

Thermocouples are subject to ageing and change their temperature/thermal voltage characteristic. Type J thermocouples of (Fe-CuNi) age slightly due to oxidation of the pure metal leg. In types K and N thermocouples (NiCrSi-NiSi), high temperatures can result in substantial changes to the thermal voltage due to chrome depletion in the NiCr leg, leading to a lower thermal voltage.

This effect is accelerated if there is a shortage of oxygen, since a complete oxide layer, which would protect it from further oxidation, cannot be formed on the surface of the thermocouple. Chromium is oxidised, but nickel isn't. This results in the so-called "**green rot**", destroying the thermocouple. When NiCr-Ni thermocouples that have been operating above 700 °C are cooled quickly, this cooling causes certain states in the crystal structure (**short-range order**) to freeze, which in type K thermocouples can result in a change of the thermal voltage of up to 0.8 mV (K effect).

In type N thermocouple (NiCrSi-NiSi), it has been possible to reduce the **short-range-order effect** by alloying both legs with silicon. The effect is reversible and is largely eliminated again by annealing above 700 °C, followed by slow cooling. Thin sheathed thermocouples are particularly sensitive. Cooling in still air can even result in deviations of more than 1 K.

Measuring insert

The measuring insert is made of a vibration-resistant, sheathed, mineral-insulated cable (MI cable). The diameter of the measuring insert should be approx. 1 mm smaller than the bore diameter of the thermowell. Gaps of more than 0.5 mm between thermowell and the measuring insert will have a negative effect on the heat transfer, and they will result in unfavourable response behaviour from the thermometer.

When fitting the measuring insert into a thermowell, it is very important to determine the correct insertion length (= thermowell length for bottom thicknesses of ≤ 5.5 mm). In order to ensure that the measuring insert is firmly pressed down onto the bottom of the thermowell, the insert must be spring-loaded (spring travel: max 10 mm). Furthermore we recommend that a neck length be selected to give a standard length for the thermometer's measuring insert. This has the advantage that the measuring insert is according to the series of standards.

Neck tube

The neck tube is screwed into the connection head. The usual size to industrial standards is M24 x 1.5 mm. The neck length depends on the intended use. Usually an isolation is bridged by the neck tube. Also, in many cases, the neck tube serves as a cooling extension between the connection head and the medium, in order to protect any possible built-in transmitter from high medium temperatures. The standard material for neck tubes is stainless steel.

Standard measuring insert lengths

Measuring insert Ø in mm	Standard measuring insert lengths in mm											
	275	315	345	375	405	435	525	555	585	655	735	
3	275	315		375		435						
6	275	315	345	375	405	435	525	555	585	655	735	
8	275	315	345	375	405	435	525	555	585	655	735	

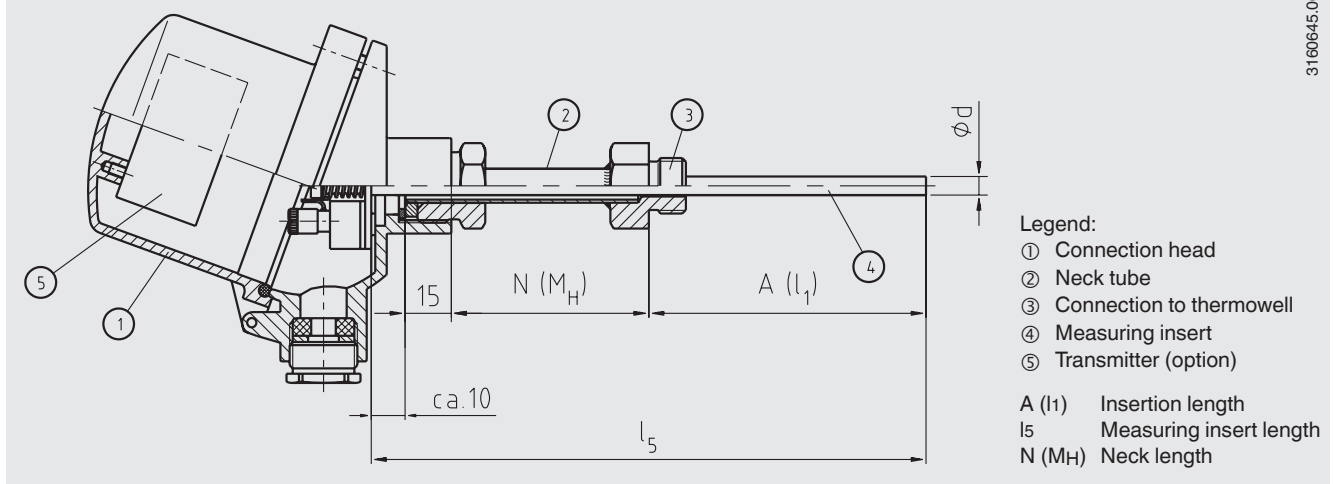
The lengths specified in this table correspond to the standard lengths. Intermediate lengths or greater lengths are possible without any difficulty.

Possible combinations of design, neck tube diameter and connection thread

Design of the screw connection at the neck tube	Connection thread at neck tube		Connection thread to the head
	Ø 12 mm	Ø 14 mm	
Threaded connection	G ½ B	G ½ B	M24 x 1.5
	G ¾ B	G ¾	M24 x 1.5
	M14 x 1.5	-	M24 x 1.5
	M18 x 1.5	M18 x 1.5	M24 x 1.5
	½ NPT	½ NPT	M24 x 1.5
	¾ NPT	¾ NPT	M24 x 1.5
Union nut (female)	G ½	G ½	M24 x 1.5
	M27 x 2	M27 x 2	M24 x 1.5
Male nut	G ½ B	G ½ B	M24 x 1.5
Neck tube without thread	-	-	M24 x 1.5
Neck tube with compression fitting	G ½ B	G ½ B	M24 x 1.5
	M27 x 2	M27 x 2	M24 x 1.5

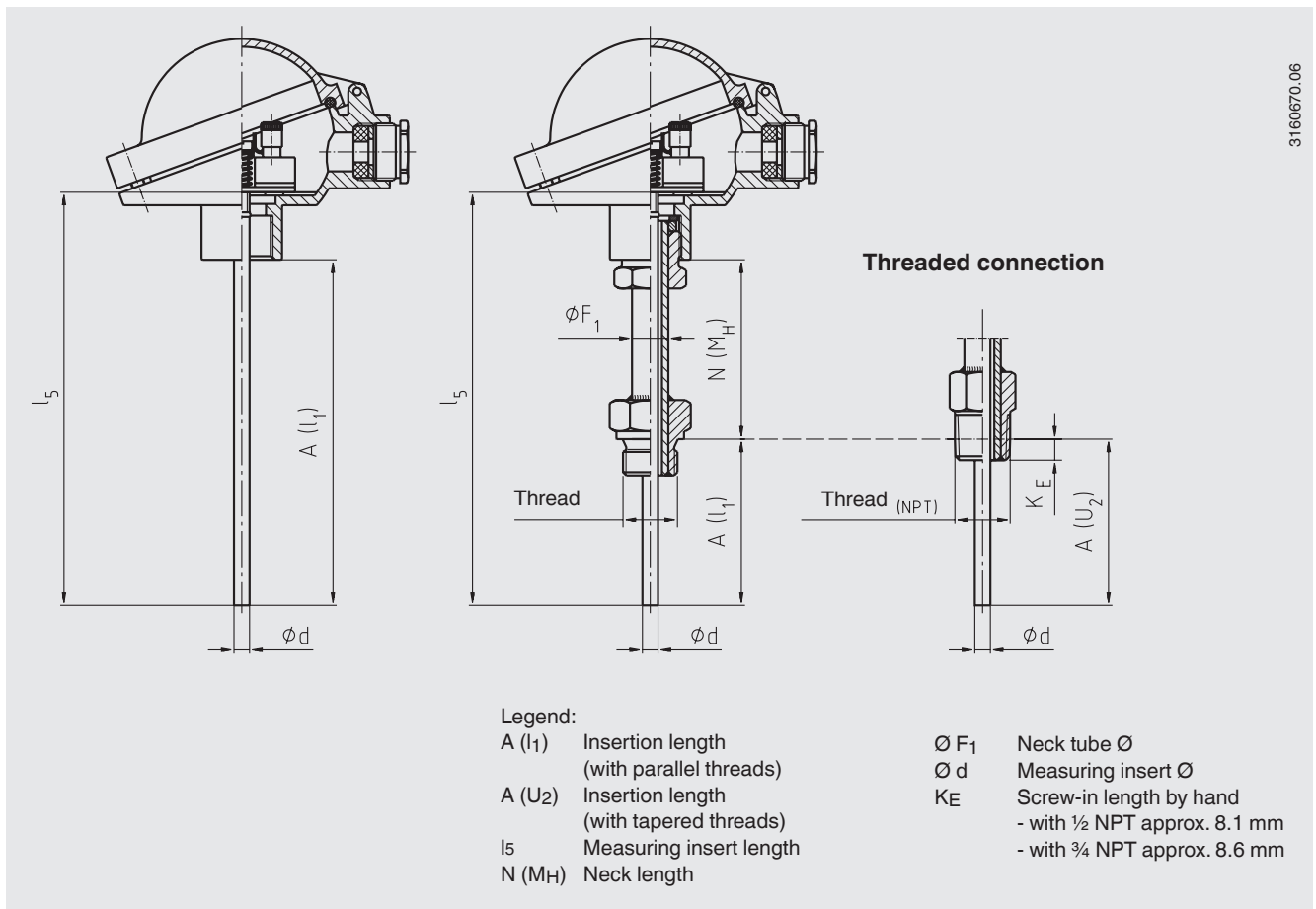
TC10-B components

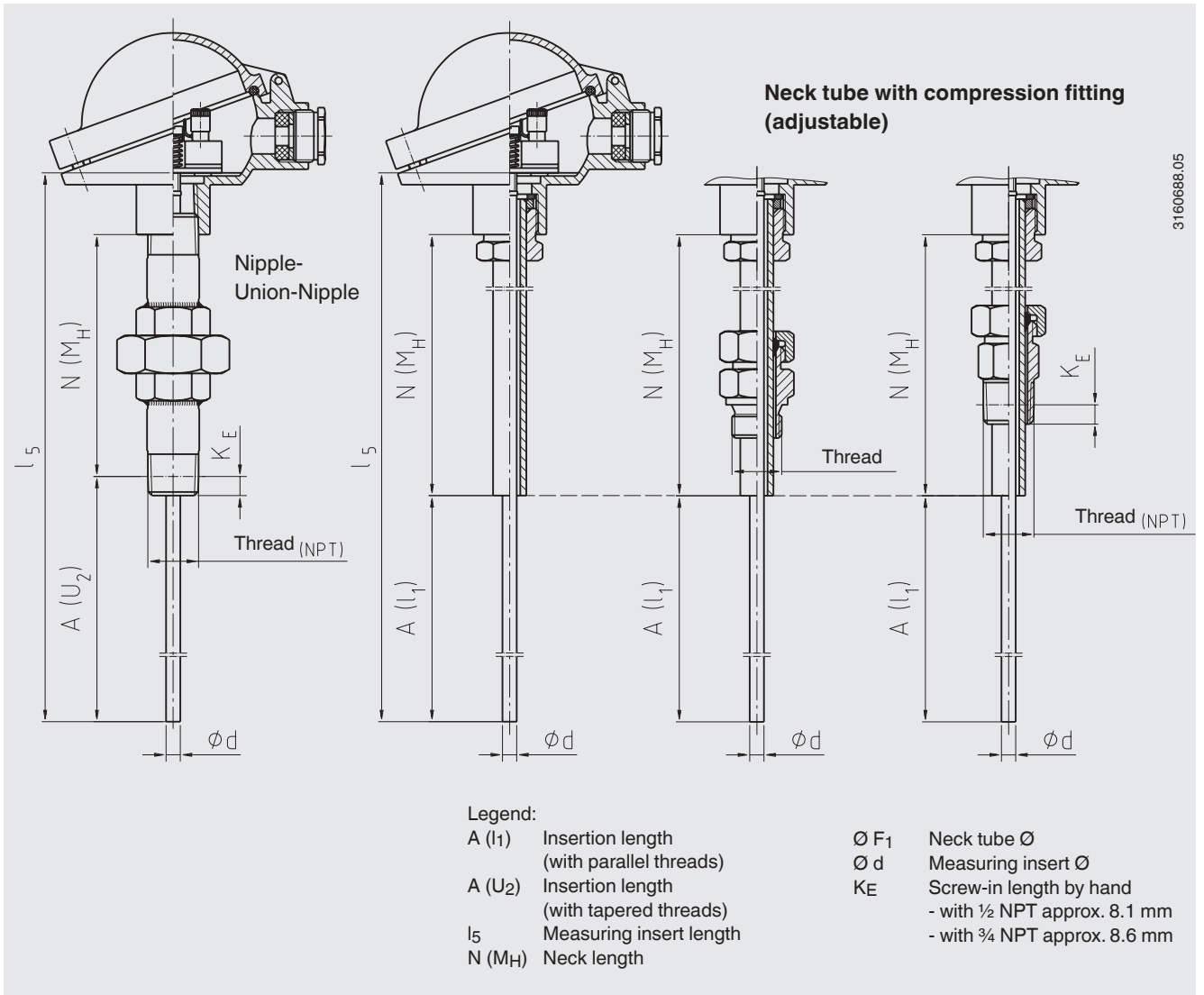
Fig. with parallel thread, for tapered thread see "Connection to thermowell"



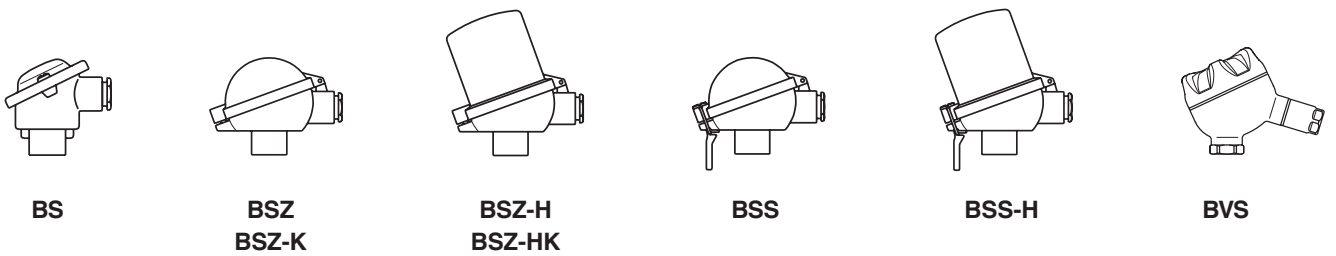
Connection to thermowell

The many possible designs ensure that the thermocouples, model TC10-B, can be combined with almost all feasible thermowells. The most usual designs of connection are shown in the following drawings; further connections on request.





Connection head



Model	Material	Cable entry	Ingress protection	Cap	Surface finish
BS	Aluminium	M20 x 1.5 ¹⁾	IP 65	Cap with 2 screws	blue, painted ²⁾
BSZ	Aluminium	M20 x 1.5 ¹⁾	IP 65	Hinged cover with cylinder head screw	blue, painted ²⁾
BSZ-K	Plastic	M20 x 1.5 ¹⁾	IP 65	Hinged cover with cylinder head screw	black
BSZ-H	Aluminium	M20 x 1.5 ¹⁾	IP 65	Hinged cover with cylinder head screw	blue, painted ²⁾
BSZ-HK	Plastic	M20 x 1.5 ¹⁾	IP 65	Hinged cover with cylinder head screw	black
BSS	Aluminium	M20 x 1.5 ¹⁾	IP 65	Hinged cover with clip	blue, painted ²⁾
BSS-H	Aluminium	M20 x 1.5 ¹⁾	IP 65	Hinged cover with clip	blue, painted ²⁾
BVS	Stainless steel	M20 x 1.5 ¹⁾	IP 65	Screw cover	precision casting, electropolished

1) Standard
2) RAL5022, polyester paint saltwater-resistant

Connection head with digital indicator (option)

As an alternative to the standard connection head the thermometer can be fitted with an optional DIH10 digital indicator. The connection head used for this is similar to the model BSZ-H head. For operation, a 4 ... 20 mA transmitter is needed, which is mounted to the measuring insert. The display range of the display is configured identically to the measuring range of the transmitter.

Designs with ignition protection type "intrinsically safe", Ex-i, are also available.



Fig. connection head with digital indicator, model DIH10

Transmitter (option)

Depending on the connection head used, a transmitter can be mounted within the thermometer.

- Mounted instead of terminal block
- Mounted within the cap of the connection head
- Mounting not possible

Connection head	Transmitter model		
	T12	T32	T53
BS	-	-	○
BSZ / BSZ-K	○	○	○
BSZ-H / BSZ-HK	●	●	●
BSS	○	○	○
BSS-H	●	●	●
BVS	○	○	○

Mounting of 2 transmitters on request.

Model	Description	Explosion protection	Data sheet
T12	Digital transmitter, PC configurable	optional	TE 12.03
T32	Digital transmitter, HART® protocol	optional	TE 32.04
T53	Digital transmitter FOUNDATION™ Fieldbus and PROFIBUS® PA	Standard	TE 53.01

Explosion protection (option)

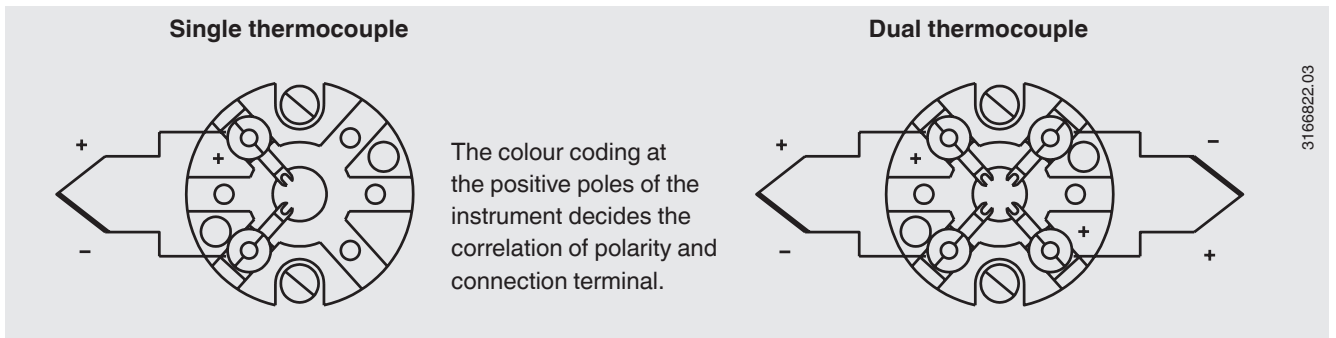
Thermocouples of the TC10-B series are available with a EC type-examination certificate for "intrinsically safe", Ex-i, ignition protection.

These instruments comply with the requirements of 94/9/EC (ATEX) directive for gas and dust. Manufacturer's declarations in accordance with NAMUR NE24 are also available.

The classification/suitability of the instrument (permissible power P_{max} as well as the permissible ambient temperature) for the respective category can be seen on the EC type-examination certificate and in the operating instructions.

Built-in transmitters have their own EC type-examination certificate. The permissible ambient temperature ranges of the built-in transmitters can be taken from the corresponding transmitter approval. The system operator is responsible for using suitable thermowells.

Electrical connection



For the electrical connections of built-in temperature transmitters see the corresponding transmitter data sheets or operating instructions.

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