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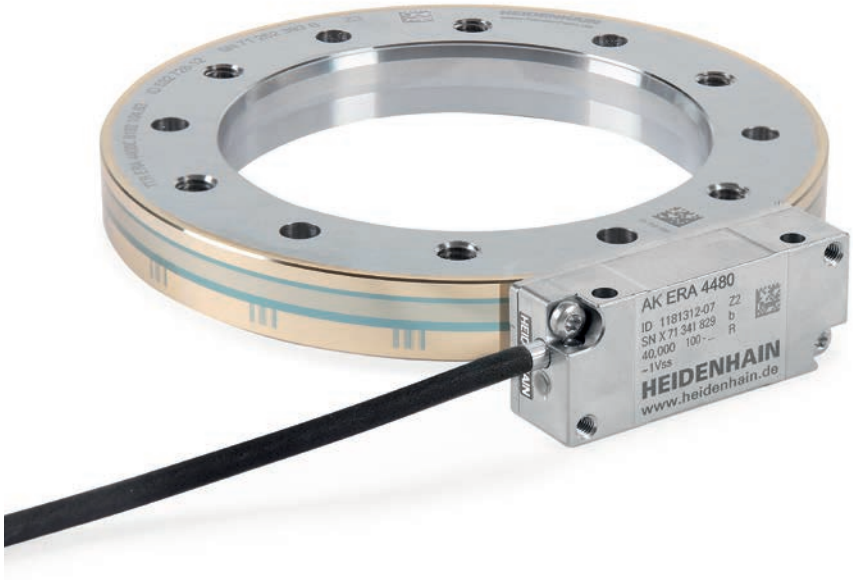


Product Information

ERA 4000

Incremental Modular
Angle Encoder with
Optimized Scanning

03/2020

Fault exclusion for the loosening of the mechanical connection

The sizing of mechanical connections in a drive system is the task of the machine manufacturer. During the mechanical design phase, the OEM will ideally consider the conditions within the application. Verifying a safe connection, however, is both cost- and time-intensive. That's why HEIDENHAIN has developed a type-examined mechanical fault exclusion for the ERA 4000.

This fault exclusion has been qualified for a wide range of encoder applications and is ensured for the operating conditions listed below. Due to the wide temperature range and numerous material characteristics, as well as the maximum permissible shaft speeds and accelerations, the scale drum requires an interference fit. The required size of this interference fit, taking all of the safety factors into account, necessitates a shrink fit for the scale drum and directly affects the required fitting temperature.

Mounting with mechanical fault exclusion is optional. If the safety design does not call for a mechanical fault exclusion, then the drum can also be fastened without an interference fit (see ***W1*** under *Dimensions*).

Both mounting options and their various requirements are described in the documentation.

Mechanical connection	**Fastening**	**Safe position for mechanical coupling**[3]	**Specifications subject to constraints**[4]
Scale drum	Interference fit as per dimension drawing: Screw connection:[1] [2] ISO 4762-M5x20-8.8 screws ISO 4762-M6x25-8.8 screws	Drum outside diameters ranging from 76.75 mm to 127.64 mm: ±0.015°	See specifications: • Vibration • Shock • Maximum angular acceleration
Scanning head	Mounting type I: Screw connection:[2] ISO 4762-M3x25-8.8 screws	Drum outside diameters greater than 127.64 mm: ±0.0°	See mounting information: • Usable materials • Mounting conditions
	Mounting type II: Screw connection:[2] ISO 4762-M3x16-8.8 screws		

[1] A material bonding anti-rotation lock must be used for the screw connections of the scale drums (mounting/servicing)
[2] Friction class B as per VDI 2230
[3] Fault exclusions exist only for the explicitly stated mounting conditions
[4] As opposed to the ERA 4000 without mechanical fault exclusion

Material
For the mating shaft and the mating stators, use materials in accordance with the table.

Mounting temperature
All information on screw connections is based on a mounting temperature of 15 °C to 35 °C.

Mounting the scale drum
An oversize of the shaft is required for fault exclusion. The preferred method is to thermally shrink the TTR ERA 4x00 scale drum onto the mating shaft and fasten it with screws. For this purpose, the scale drum must be slowly heated prior to mounting. This can be conveniently done with an oven or heating plate. The diagram shows the recommended minimum temperatures for the different drum diameters. The maximum temperature must not exceed 140 °C.

During shrink-fitting, make sure that the hole patterns of the scale drum and mating shaft are properly aligned. Appropriate centering aids (setscrews) can facilitate mounting. All of the mounting screws must be retightened at the correct torque after the scale drum has cooled. The mounting screws used for the assembly of the scanning head and scale drum may be used only to secure the scanning head and the scale drum. These screws may not be used to additionally fasten other components.

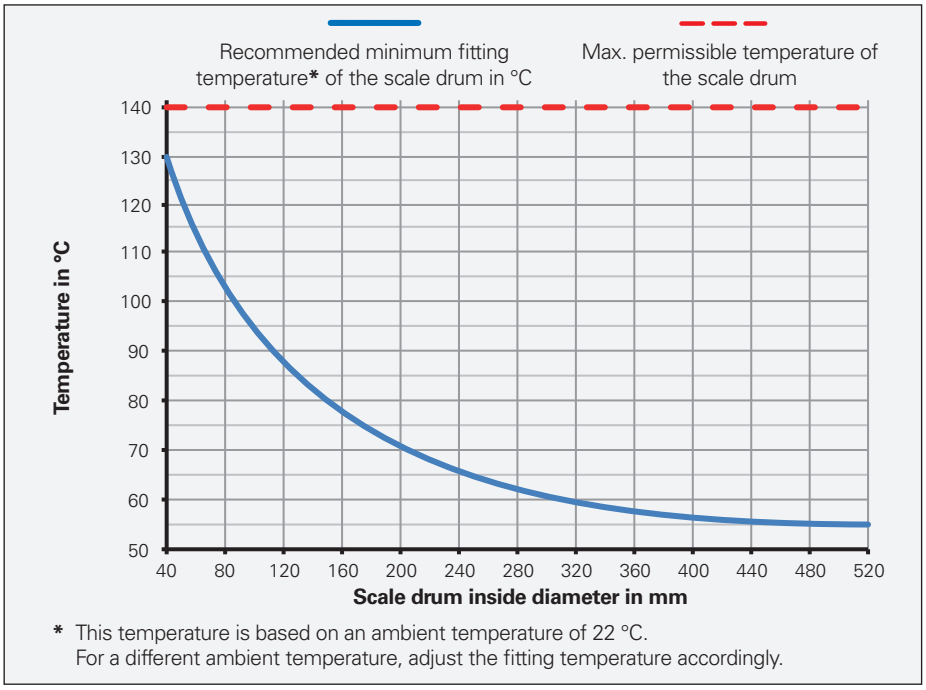
Removing the scale drum
The scale drum is removed using the relevant back-off threads in the drum. To do so, screw in greased screws, and tighten them in a row until the scale drum comes off the shaft.

Mounting the scanning head
Ensure that the diameter specifications for all encoder components match (scale drum, scanning head, mounting aid). The relevant information is indicated on the respective ID labels.

Accessory:
- Mounting aid (corresponding to drum diameter)

Mating shaft/mating stator	
Material	Steel
Tensile strength R_m	≥ 600 N/mm^2
Shear strength τ_m	≥ 390 N/mm^2
Modulus of elasticity	≥ 200 000 N/mm^2 to 215 000 N/mm^2
Coefficient of thermal expansion α_{therm} [1)]	$10 \cdot 10^{-6}$ K^{-1} to $13 \cdot 10^{-6}$ K^{-1}

[1)] Others upon request



* This temperature is based on an ambient temperature of 22 °C.
For a different ambient temperature, adjust the fitting temperature accordingly.

Function indicator

The ERA 4000 angle encoders possess a built-in function indicator in the form of a multicolor LED, permitting fast and easy signal-quality checks during operation.

This feature provides a number of benefits:
- Scanning-signal quality visualization through a multicolor LED
- Continuous monitoring of incremental signals over the entire measuring length
- Indication of reference-mark signal behavior
- Quick operating checks in the field without additional aids

The built-in function indicator permits both reliable assessment of the incremental signals and inspection of the reference mark signal. The quality of the **incremental signals** is indicated by a range of colors permitting quite detailed signal-quality differentiation. The tolerance conformity of the **reference mark signal** is shown by means of a pass/fail indicator.

ERA 4000 with function indicator in the scanning head

LED indicator for incremental signals

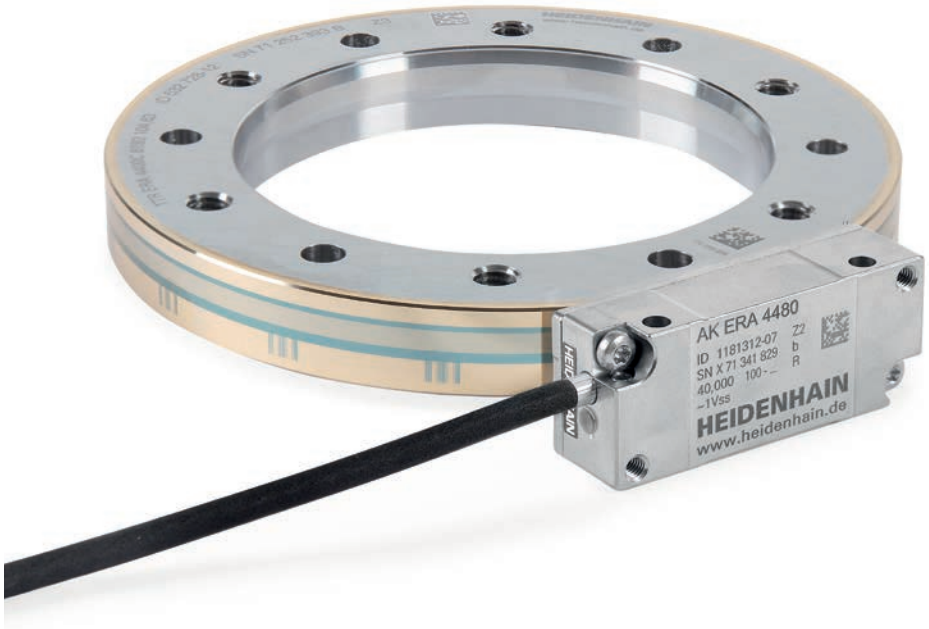
LED color	Quality of the scanning signals
●	Optimal
●	Good
●	Acceptable
●	Unsatisfactory

LED indicator for reference-mark-signal
(operating check)
When the reference mark is traversed, the LED briefly lights up in red or blue:
- ● Out of tolerance
- ● In tolerance

ERA 4000 series

High-accuracy incremental angle encoder
- **Steel scale drum with three-point centering or centering collar**
- **Optimized scanning performance for very high reliability**
- **Integrated three-color LED function indicator**
- **Consists of a scanning head and scale drum**

Scanning head	**AK ERA 4280** with 20 µm graduation period **AK ERA 4480** with 40 µm graduation period **AK ERA 4880** with 80 µm graduation period
Interface	⁓ 1 V_{PP} HSP
Cutoff frequency –3 dB	1 MHz
Electrical connection	1 m or 3 m cable 12-pin M12 coupling or 12-pin M23 coupling or 15-pin D-sub connector
Cable length	≤ 150 m (with HEIDENHAIN cable)
Supply voltage	DC 5 V ±0.5 V
Current consumption	< 130 mA (without load)
Vibration 55 Hz to 2000 Hz **Shock** 11 ms 6 ms	With mechanical fault exclusion: ≤ 200 m/s^2 (EN 60068-2-6) Without mechanical fault exclusion: ≤ 200 m/s^2 (EN 60068-2-6) With mechanical fault exclusion: ≤ 200 m/s^2 (EN 60068-2-27) Without mechanical fault exclusion: ≤ 1000 m/s^2 (EN 60068-2-27)
Operating temperature	–10 °C to 70 °C
Relative air humidity	≤ 93% (at 40 °C/4d as per EN 60068-2-78); condensation excluded
Protection	IP40
Mass Scanning head Cable Coupling (M12) Coupling (M23) D-sub connector	 ≈ 20 g (without cable) ≈ 20 g/m ≈ 15 g ≈ 50 g ≈ 32 g



Scale drum with centering collar		
Measuring standard Coefficient of expansion		
Signal periods/ interpolation error per signal period[1)]	ERA 4200	
	ERA 4400	
	ERA 4800	
Accuracy of graduation		
Reference marks		
Drum inside diameter*		
Drum outside diameter*		
Mechanically permissible speed	with mechanical fault exclusion	
	without mechanical fault exclusion	
Moment of inertia		
Maximum angular acceleration with mechanical fault exclusion		
Permissible axial movement		
Protection EN 60529		
Mass		

	TTR ERA 4200C with 20 µm graduation period **TTR ERA 4400C** with 40 µm graduation period **TTR ERA 4800C** with 80 µm graduation period								
	Steel drum $\alpha_{therm} \approx 10.4 \cdot 10^{-6}\ K^{-1}$								
	–	16384/±0.24″	20000/±0.19″	28000/±0.14″	32768/±0.12″	40000/±0.10″	52000/±0.07″	–	–
	6000/±1.08″	8192/±0.79″	10000/±0.65″	14000/±0.46″	16384/±0.40″	20000/±0.32″	26000/±025″	38000/±0.17″	44000/±0.15″
	3000/±2.16″	4096/±1.58″	5000/±1.30″	7000/±0.93″	8192/±0.79″	10000/±0.65″	13000/±0.50″	–	–
	±5″	±3.7″	±3″	±2.5″				±2″	
	Distance-coded or one								
	40 mm	70 mm	80 mm	120 mm	150 mm	180 mm	270 mm	425 mm	512 mm
	76.75 mm	104.63 mm	127.64 mm	178.55 mm	208.89 mm	254.93 mm	331.31 mm	484.07 mm	560.46 mm
	10000 rpm	8500 rpm	6250 rpm	4500 rpm	4250 rpm	3250 rpm	2500 rpm	1800 rpm	1500 rpm
	20000 rpm	15000 rpm	12250 rpm	8750 rpm	7500 rpm	6250 rpm	4750 rpm	3250 rpm	2750 rpm
	$0.27 \cdot 10^{-3}$ kgm^2	$0.81 \cdot 10^{-3}$ kgm^2	$1.9 \cdot 10^{-3}$ kgm^2	$7.1 \cdot 10^{-3}$ kgm^2	$12 \cdot 10^{-3}$ kgm^2	$28 \cdot 10^{-3}$ kgm^2	$59 \cdot 10^{-3}$ kgm^2	$195 \cdot 10^{-3}$ kgm^2	$258 \cdot 10^{-3}$ kgm^2
	20000 rad/s^2	14000 rad/s^2	6600 rad/s^2	2700 rad/s^2	1800 rad/s^2	1000 rad/s^2	1300 rad/s^2	900 rad/s^2	1200 rad/s^2
	≤ ±0.5 mm (scale drum relative to the scanning head)								
	Complete encoder in mounted condition: IP00								
	≈ 0.28 kg	≈ 0.41 kg	≈ 0.68 kg	≈ 1.2 kg	≈ 1.5 kg	≈ 2.3 kg	≈ 2.6 kg	≈ 3.8 kg	≈ 3.6 kg

***** Please select when ordering

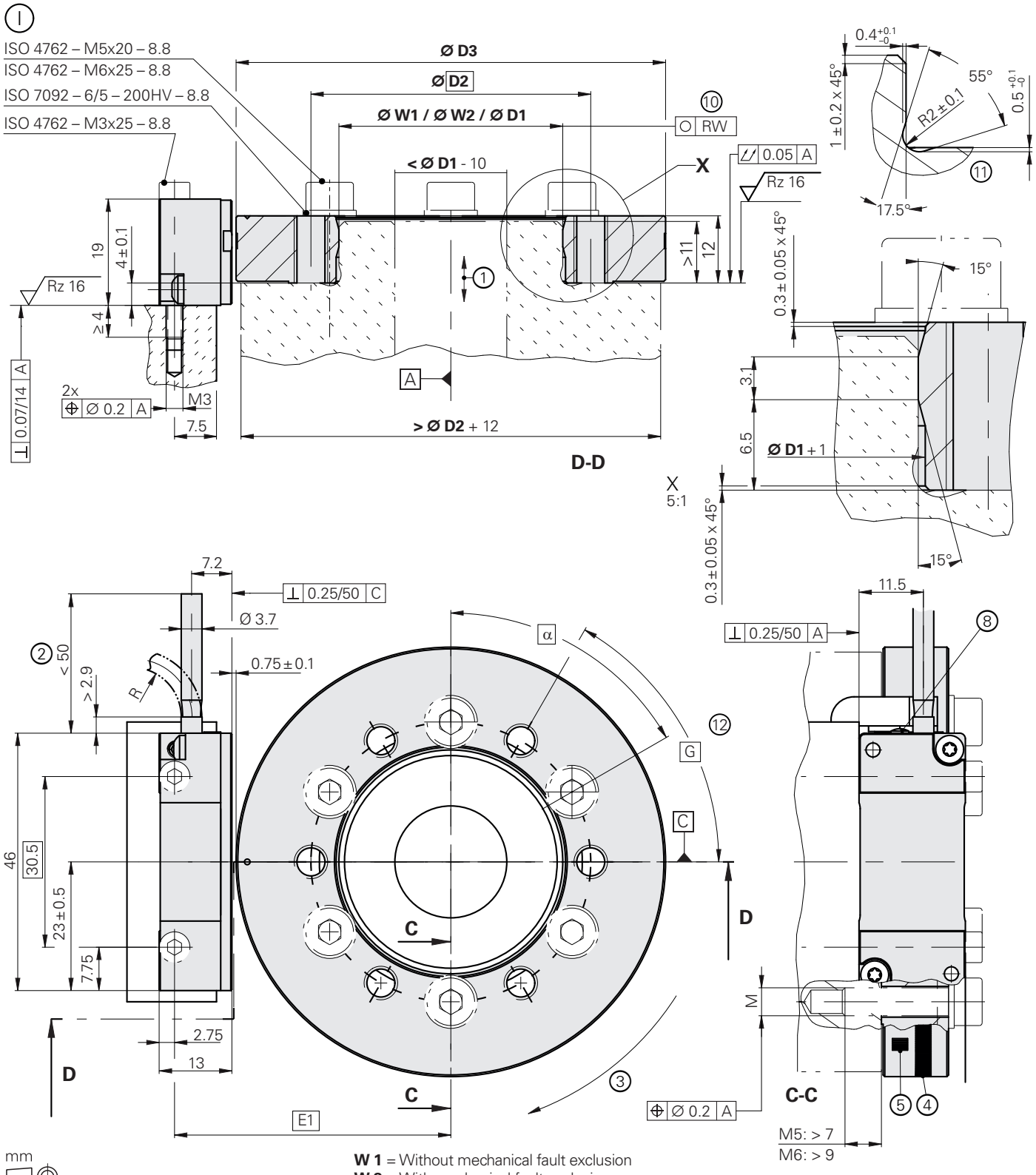
[1] The interpolation error within one signal period and the accuracy of the graduation together yield the encoder-specific error; for additional error from mounting and bearing of the measured shaft, see *Measuring accuracy*

Scale drum with three-point centering	**TTR ERA 4202C** with 20 µm graduation period					
Measuring standard Coefficient of expansion	Steel drum $\alpha_{therm} \approx 10.4 \cdot 10^{-6}\ K^{-1}$					
Signal periods	16384	20000	28000	32768	40000	52000
Accuracy of graduation	±3″	±2.5″	±2″	±1.9″	±1.8″	±1.7″
Interpolation error per signal period[1)]	±0.24″	±0.19″	±0.14″	±0.12″	±0.10″	±0.07″
Reference marks	Distance-coded or one					
Drum inside diameter*	70 mm	80 mm	120 mm/ 150 mm	150 mm/ 185 mm	180 mm/ 210 mm	270 mm
Drum outside diameter*	104.63 mm	127.64 mm	178.55 mm	208.89 mm	254.93 mm	331.31 mm
Mech. permissible speed	15000 rpm	12250 rpm	8750 rpm	7500 rpm	6250 rpm	4750 rpm
Moment of inertia	$0.83 \cdot 10^{-3}$ kgm^2	$2.0 \cdot 10^{-3}$ kgm^2	$7.1/4.5 \cdot 10^{-3}$ kgm^2	$12/6.4 \cdot 10^{-3}$ kgm^2	$28/20 \cdot 10^{-3}$ kgm^2	$59 \cdot 10^{-3}$ kgm^2
Permissible axial movement	≤ ±0.5 mm (scale drum relative to the scanning head)					
Protection EN 60529	*Complete encoder in mounted condition:* IP00					
Mass	≈ 0.42 kg	≈ 0.69 kg	≈ 1.2 kg/ 0.66 kg	≈ 1.5 kg/ 0.66 kg	≈ 2.3 kg/ 1.5 kg	≈ 2.6 kg

***** Please select when ordering

[1)] The interpolation error within one signal period and the accuracy of the graduation together yield the encoder-specific error; for additional error from mounting and bearing of the measured shaft, see *Measuring accuracy*

ERA 4280C, ERA 4480C, ERA 4880C
Dimensions

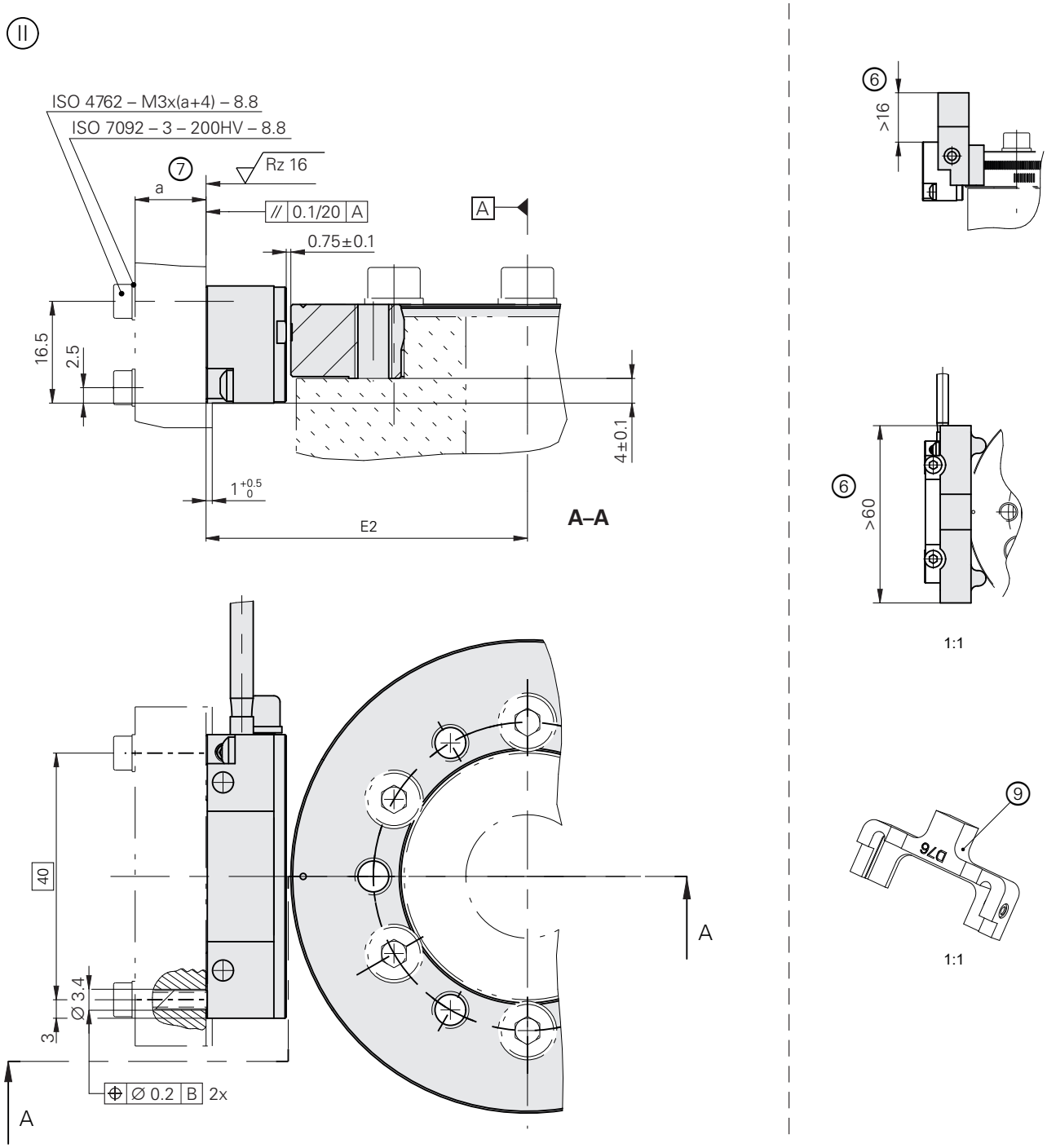


mm

Tolerancing ISO 8015
ISO 2768 - m H
≤ 6 mm: ±0.2 mm

W 1 = Without mechanical fault exclusion
W 2 = With mechanical fault exclusion

Ⅰ, Ⅱ = Mounting possibilities
Ⓐ = Bearing of mating shaft
W = Mating diameter (shaft)
1 = Permissible axial motion of the measured shaft: ≤ ±0.5 mm
2 = Cable support
3 = Positive direction of rotation
4 = Incremental track
5 = Reference pulse track
6 = Space for mounting aid
7 = With mechanical fault exclusion: a = 11.5 mm ±0.1 mm
8 = Function indicator
9 = Mounting aid (accessory)
10 = Roundness of mating diameter (shaft)
11 = Proposed design for undercut
12 = Back-off thread; not permitted for drum fastening



D1	W1	W2	RW	D2	D3	E1	E2	α	M	G
Ø 40 –0.001/–0.005	Ø 40 +0.004	Ø 40 +0.004/+0.000	0.001	Ø 50	Ø 76.75	49.38	52.13	6x60°	6x M5	6x M6
Ø 70 –0.001/–0.005	Ø 70 +0.005	Ø 70 +0.007/+0.002	0.001	Ø 85	Ø 104.63	63.32	66.07	6x60°	6x M5	6x M6
Ø 80 –0.001/–0.005	Ø 80 +0.006	Ø 80 +0.009/+0.003	0.0015	Ø 95	Ø 127.64	74.82	77.57	6x60°	6x M5	6x M6
Ø 120 –0.001/–0.008	Ø 120 +0.008	Ø 120 +0.040/+0.022	0.002	Ø 140	Ø 178.55	100.27	103.02	6x60°	6x M5	6x M6
Ø 150 –0.001/–0.008	Ø 150 +0.008	Ø 150 +0.046/+0.028	0.002	Ø 165	Ø 208.89	115.44	118.19	6x60°	6x M5	6x M6
Ø 180 –0.001/–0.008	Ø 180 +0.010	Ø 180 +0.050/+0.030	0.003	Ø 200	Ø 229.46	125.73	128.48	6x60°	6x M5	6x M6
Ø 180 –0.001/–0.008	Ø 180 +0.010	Ø 180 +0.050/+0.030	0.003	Ø 200	Ø 254.93	138.46	141.21	6x60°	6x M5	6x M6
Ø 270 0/–0.01	Ø 270 +0.012	Ø 270 +0.067/+0.044	0.003	Ø 290	Ø 331.31	176.65	179.40	12x30°	12x M5	12x M6
Ø 425 0/–0.01	Ø 425 +0.015	Ø 425 +0.094/+0.067	0.006	Ø 445	Ø 484.07	253.04	255.79	12x30°	12x M6	12x M6
Ø 512 0/–0.015	Ø 512 +0.016	Ø 512 +0.109/+0.076	0.007	Ø 528	Ø 560.46	291.23	293.98	18x20°	18x M6	12x M8