BULLETIN 8707N

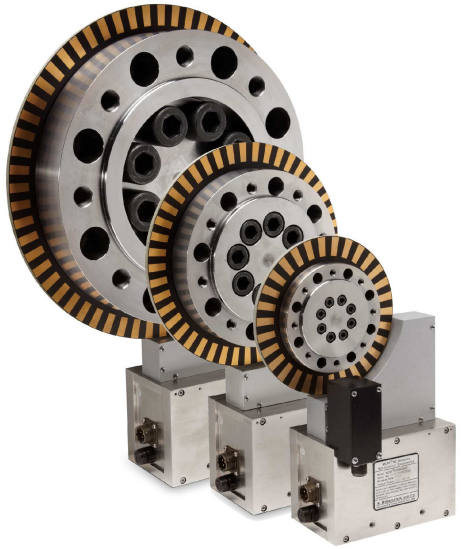
MCRT® 84700V Series Bearingless Dual-Range Digital Torquemeters

High Ranges: 500 to 100,000 lbf-in (56.5 Nm to 11,300 Nm); Low Ranges: 100 to 20,000 lbf-in (11.3 Nm to 2,260 Nm)

BEST* ACCURACY UNDER REAL - WORLD CONDITIONS

WIDEST INSTALLED MEASUREMENT BANDWIDTH AND FASTEST INSTALLED RESPONSE
SIMPLE TO INSTALL, TOLERANT OF WIDE ROTOR-STATOR MISALIGNMENT
LOWEST SENSITIVITY TO CLAMPING LOADS
HIGHEST OVERRANGE AND OVERLOAD
WORLD CLASS TEMPERATURE PERFORMANCE
GREATEST IMMUNITY TO EXTERNAL NOISE
BI-DIRECTIONAL ROTOR SHUNT CALIBRATION
NO HOOP OR CALIPER ANTENNAE

- 0.02% Combined Nonlinearity & Hysteresis
- 200% & 1,000% Overload
- 300% Overrange
- 0.0003%/°F Temperature Compensation
- 3 kHz Signal Bandwidth
- Analog and FM Outputs
- Digital Torque & Temperature Output
- 12 Units of Measure
- 13 Bessel Data Filters
- Max/Mins Updated at 20 kHz
- Interface Software Furnished



* NIST traceable calibrations are performed in our accredited laboratory (NVLAP Lab Code 200487-0). For details visit our website or follow the accreditation link at www.nist.gov

MCRT® 84700V Dual Range Torquemeters ***measure high and low torques with high accuracy and without the cost and inconvenience of swapping two conventional sensors***. They correctly measure torque if the peak to average torque ratio is high. Their use avoids the accuracy loss that occurs if an oversized sensor is used to prevent damage.

Accuracy is high in real-world applications, not just in the cal lab. That's due, in part, to very high stiffness which yields wider installed bandwidth and faster response than any competitive[1] device. Industries highest overrange avoids errors[2] from clipped torque peaks. World class temperature performance reduces drive heating and gradient errors. Also enhancing real world performance is noise hardening against EMI from VFD's, ISM transmitters and other noise sources.

1. See Application Note 221101D 2. See Application Note 20805B

Each range is calibrated to full scale with 8 to 9 CW and CCW steps (17 to 20 total) and documented by a NVLAP approved Certificate certifying NIST traceability and that our laboratory operation and quality management system meet ISO/IEC 17025:2005. A bi-directional rotor shunt cal verifies calibration and operation of the entire data chain in ***CW and CCW modes***. It is invoked via stator switches, I/O line or from your computer.

Multiple bridges and elegant design provide ***exceptional immunity to clamping and other extraneous loads.*** The torque signal is digitized on the rotor and sent to the stator where analog, frequency and Com Port outputs are created. Choose RS232/RS422/RS485 or USB communications. Included software interfaces with your Windows-based PC. It displays Real-time, Max/Min and Spread Torque, Rotor Temperature, checks limits, does torque/time plots and stores test results.

S. HIMMELSTEIN AND COMPANY

Designing and Making the World's Best Torque Instruments Since 1960

Exceptional Immunity To Noise And Interference From ISM Transmitters

Bearingless Torquemeters use unshielded antennae. As a result, any device (including a like Torquemeter) operating at or near their carrier frequency, can cause interference. FCC rules allow ISM devices to generate unlimited energy. Because most Bearingless Torquemeters use an ISM frequency for data transfer, they are susceptible to interference from other ISM devices.

Since FCC rules only allow narrow band (typically ±7 kHz) transmission for unlicensed use, wideband ISM frequency Torquemeters risk violation of FCC regulations. Himmelstein Bearingless Torquemeters use non-ISM frequencies for power and data, have field strengths within FCC rules, powerful 12 pole signal filters and near field (not radiated field) signal transfer.

Common Specifications*	**High Range**	**Low Range**
Torque Range[1]	Factory Set @ Transducer Full Scale Torque; see Note 1.	
Torque Units of Measure	Select lbf-in, lbf-ft, ozf-in, ozf-ft, N-m, kN-m, N-cm, kgf-m, kgf-cm, gf-cm without re-calibration	
Temperature Units of Measure	Select °F or °C without re-calibration	
Combined Nonlinearity & Hysteresis (% or Range, Best Fit Line Basis - see Tech Memo 230104)	≤ ±0.02% of High Range	≤ ±0.03% of Low Range
Overrange[2] (% of Range)	150	300
Overload (% of Range)	200	1,000
Repeatability	≤ ±0.015% of Range	≤ ±0.015% of Range
Accuracy[3] (nonlinearity, hysteresis & repeatability)	≤ ±0.03% of High Range	≤ ±0.04% of Low Range
Calibration Signal[4]	100.00% of full scale for clockwise and counterclockwise directions.	
Bi-polar Shunt Calibration Enable	From Stator Switches (one CW, one CCW), via TTL I/O, or PC Com Port using furnished software.	
Zero Drift (% of Range per °F/*per* °C)	≤ ±0.0003/*0.00054*	≤ ±0.0015/*0.0027*
Span Drift (% of Reading per °F/*per* °C)	≤ ±0.002/*0.0036*	≤ ±0.002/*0.0036*
48 Hour Drift (% of Range - applies to all outputs)	≤ ±0.01	≤ ±0.05
Temperature Ranges (°F/°C)	Compensated Range: +75 to +175/*+24 to +79.4*; Usable Range: -25 to +185/*-32 to +85* Storage Range: -65 to +225/*-54 to +107*	
Rotor to Stator Maximum Misalignment (inches/*mm*)	Axial: ±0.4/*10.2*, Radial: 0.3/7.6 with or without Optical (Code O) Speed Pickup Option. If Magnetic (Code Z) Speed Pickup Option is installed, then both maximums become 0.04/*1.0*.	
Effect of Clamping Loads (% of Range)	≤ ±0.02	≤ ±0.1
Analog Output Signals[5]**, Auto-Scaled**	Allowable Load: 10k resistive, minimum; 0.05μF capacitive, maximum.	
Full Scale Torque, Both Ranges	±10V with ±15V overrange. User may select ±5V with ±7.5V overrange. Caution: see Note 2.	
	±5V with ±15V overrange. User may select ±10V with ±15V overrange. Caution: see Note 2.	
Signal Filter Cutoff Frequency[6]	Field selectable from 0.1 Hz to 1 kHz in thirteen 1-2-5 steps plus 3 kHz. Selected from a remote PC using furnished software.	
Frequency Modulated Output[5]	Frequency: 10±5 kHz or 20±10 kHz or 40±20 kHz; field changeable (Default = 10±5 kHz); TTL square wave output.	
Peak-Peak Digital Output[5] **Noise vs Filter Cutoff Frequency** (% of Range)	0.0002 @ 0.1Hz and 1 Hz, 0.004 @ 10 Hz, 0.011 @ 100 Hz, 0.04 @ 1kHz, 0.06 @ 3 kHz	0.001 @ 0.1Hz and 1 Hz, 0.02 @ 10 Hz, 0.05 @ 100 Hz, 0.2 @ 1kHz, 0.3 @ 3 kHz
Peak-Peak Analog Output[5,7] **Noise vs Filter Cutoff Frequency** (millivolt)	4 @ 0.1 thru 10 Hz, 5 @ 100 Hz thru 1 kHz, 6 @ 3 kHz	4 @ 0.1 thru 10 Hz, 8 @ 100 Hz, 17 @ 1 kHz, 28 @ 3 kHz
Torque Sampling Rate and Bandwidth	Sampled @ 20 kHz. Torque 3 dB bandwidth is 3 kHz reducible by filters (see Note 6 & above).	
System Resolution[2] (% of Range)	0.01	
Rotor-to-Stator Transfer Rate	1.25 MBaud	
RS232/RS422/RS485/USB Communication[8]	Com port outputs Torque and Temperature with units of measure. Inputs torque range if other than sensor full scale, selects units of measure, selects filter cutoff, etc. and permits remote test control.	
BAUD Rate	115,200; Drivers are protected for short circuit (current limit) and ±15 kV ESD protected.	
Maximum Cable Length	RS232 = 50 feet, RS422/485 = 4,000 feet; 120 Ohm termination may be accessed via software.	
Interface Software With Torque Limits	Provided to interface with Windows-based PC. Includes 20 foot interconnect cable[7] for a PC.	
I/O Lines and FM Output[5]	Input lines are +CAL, -CAL, TARE, CLEAR TARE, and RESET MAX/MIN. Output lines are Data OK and FM Output.	
Status LED's (on Stator Keypad)	Three Color Coded LED's: **Power** (Yellow = Power-up, Green = OK, Red = Fault); **Data** (Green = OK, Red = Data Error); **Rotor Temperature** (Green = In Operating Range, Red = Out of Operating Range).	
Keypad Control Switches	+ CAL invokes CW Rotor Shunt Cal, -CAL invokes CCW Rotor Shunt Cal, Both held simultaneously for 5 seconds invokes TARE.	
Rotor Temperature	Rotor temperature is output via Com Port. Range is 0 to 185 °F.; Accuracy is ±2 °F.	
Optional Zero Velocity Speed Pickups	Optical and Magnetic pickups output pulse train. Magnetic type restricts misalignment; see above.	
Supply Voltage/Power[9]	10 to 26 VDC @ 6 to 11 Watts nominal, varies with rotor misalignment.	

Specification Notes:

1. Outputs may be set at any value ≤ Torquemeter Full Scale Rating. *For example:* If the Full Scale Rating is 10,000 lbf-in, the user may re-scale to 5,000 lbf-in. Then the analog output would be 5 or 10 Volts at 5,000 lbf-in and the digital output, at the Com Port, would be 5,000. However, the above specification still defines measurement accuracy. In other words, you can use this capability to change the scaling but it will not change measurement accuracy; see Application Note 20804 for further details on Torquemeters operated with extended measuring range.
2. ***In the overrange region*** all outputs are guaranteed to have combined nonlinearity and hysteresis lower than 0.1% of full scale. This avoids large average and peak torque errors that driveline resonance and pulsating driver and load devices can cause near the high end of the sensor range. See Application Note 20805B for more complete information. Torquemeters have infinite fatigue life for full reversals up to half their overload rating. Above that, you risk a fatigue failure.
   If you are using the analog output, it is linear up to 15 volts. That corresponds to 150% of full scale on the 10 volt output setting and 300% on the 5 volt output setting. Accordingly, when using the analog output and if you expect torque peaks greater than 150% of full scale, you should switch to the 5 volt setting.
3. Assumes torque range is set to the device full scale torque rating.
4. CW torque causes CW rotation if viewed from the driving end. CCW torque causes the opposite rotation.
5. Power input and all outputs are protected. Digital inputs are reverse polarity and over-voltage protected.
6. Torque signal bandwidth upper limit is 3 kHz determined by the integral anti-aliasing filter. Realizable, installed measurement bandwidth is limited by driveline components. A torquemeters principle contribution is determined by its torsional stiffness; see Application Note 221101D for further information.
7. Analog noise is measured by an Agilent U1520A Scope with bandwidth set to 10 kHz.
8. A 20 foot long Torquemeter to RS422/485 PC port cable is shipped with each Torquemeter. That communication protocol provides for long, robust connection in a noisy industrial environment, and permits connection of multiple Torquemeters to a single, host computer. Since many PC's are only equipped with USB ports, a USB to RS232/485 adapter is also furnished.
9. Fused and reverse polarity protected.

* Specifications are subject to change without notice.

ORDER NUMBER FORMAT ☞ MCRT® 84700V A B C

A = Range from tables above; (2-4) or (5-4), etc.

B = Optional Zero Velocity Speed Pickup; N for None, Z for Magnetic Type, O for Optical Type

C = Speed Rating Suffix; H designates high speed rating, B designates lower speed rating

ORDER NUMBER EXAMPLE ☞ MCRT® 84707V(1-5)OH specifies a Dual Range Bearingless Torquemeter with a 100,000 lbf-in High Range Rating, a 20,000 lbf-in Low Range Rating, a 200,000 lbf-in Torque Overload rating, an Optical Speed Pickup and a 10,000 rpm Maximum Speed Rating.

MCRT® 84700V Dual Range Bearingless Digital Torquemeters

MCRT® MODEL	High Range			Low Range			Both Ranges
	Full Scale Torque		Maximum Deflection	Full Scale Torque		Maximum Deflection	Maximum Speed
	(lbf-in)	(N-m)	(degree)	(lbf-in)	(N-m)	(degree)	(rpm)
84702V(5-2)	500	56.5	0.054	100	11.3	0.011	15,000 Suffix H or 8,500 Suffix B
84702V(1-3)	1,000	113	0.039	200	22.6	0.008	
84704V(2-3)	2,000	226	0.028	400	45.2	0.006	13,500 Suffix H or 8,000 Suffix B
84704V(5-3)	5,000	565	0.063	1,000	113	0.012	
84704V(1-4)	10,000	1,130	0.045	2,000	226	0.009	
84704V(2-4)	20,000	2,260	0.034	4,000	452	0.007	
84707V(5-4)	50,000	5,650	0.051	10,000	1,130	0.010	10,000 Suffix H or 6,000 Suffix B
84707V(1-5)	100,000	11,300	0.039	20,000	2,260	0.008	

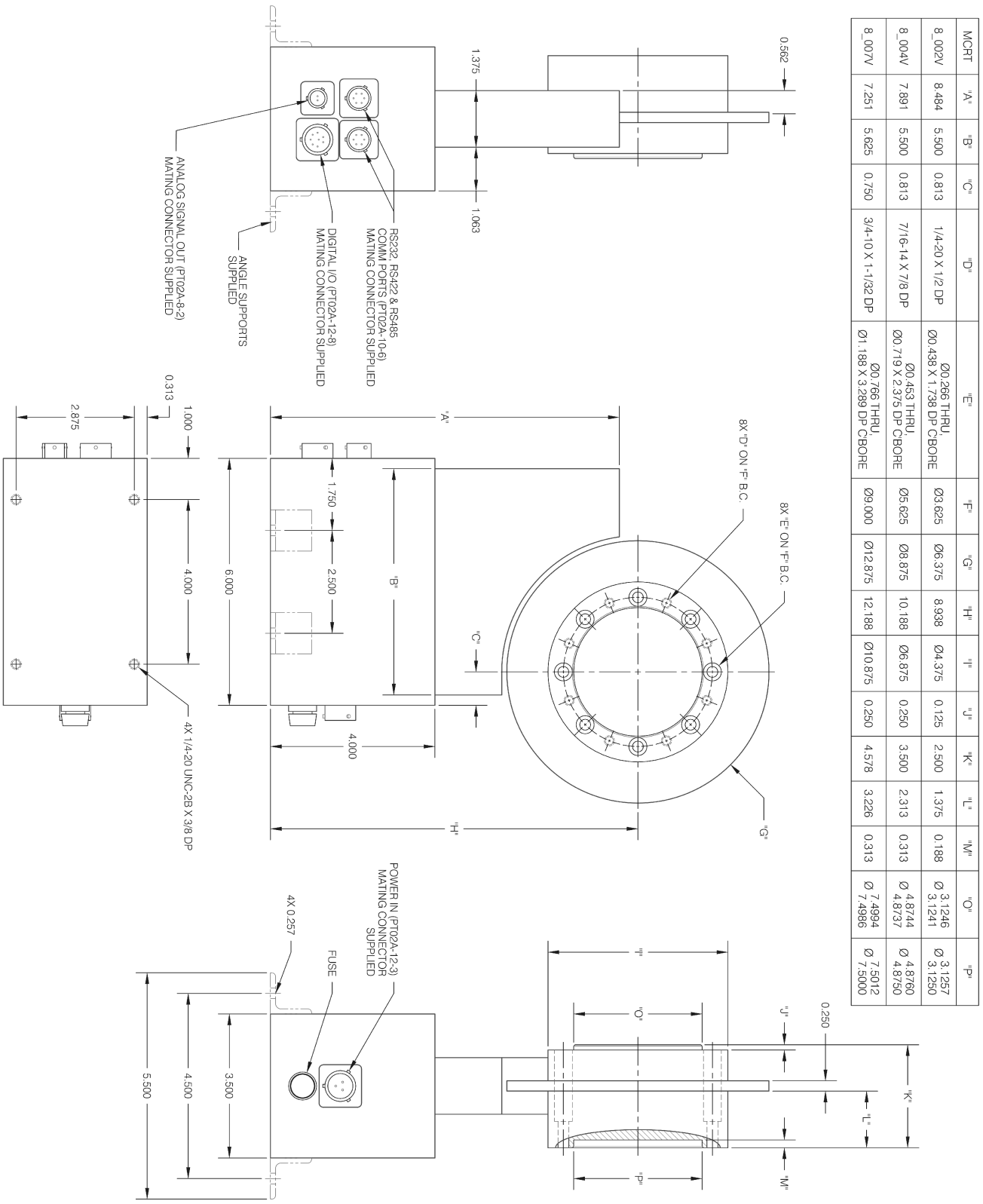
MCRT® MODEL	All Models. (Torque Overload is 200% of the High Range Torque Rating)					Maximum Rotor Weight
	Torsional Stiffness	Rotating Inertia	Maximum Thrust*	Maximum Bending*	Maximum Shear*	
English Units ☞	(lbf-in/rad)	(ozf-in s^2)	(lbf)	(lbf-in)	(lbf)	(lb)
84702V(5-2)	528,000	0.634	500	250	125	5.0
84702V(1-3)	1,480,000	0.635	1,000	500	250	5.0
84704V(2-3)	4,020,000	0.638	2,000	1,000	500	5.0
84704V(5-3)	4,560,000	3.96	3,000	1,500	800	13.3
84704V(1-4)	12,600,000	3.97	4,000	2,000	1,000	13.4
84704V(2-4)	33,900,000	3.99	6,000	3,000	2,000	13.5
84707V(5-4)	55,900,000	29.3	15,000	7,500	4,000	43.3
84707V(1-5)	145,000,000	29.7	25,000	12,500	5,000	44.1
SI Units ☞	(N-m/rad)	(kg-m^2)	(N)	(N-m)	(N)	(kg)
84702V(5-2)	59,650	0.00448	2,220	28.2	556	2.3
84702V(1-3)	167,000	0.00448	4,450	56.5	1,110	2.3
84704V(2-3)	454,000	0.00451	8,900	113	2,220	2.3
84704V(5-3)	515,000	0.0280	13,300	169	3,560	6.0
84704V(1-4)	1,424,000	0.0280	17,800	226	4,450	6.1
84704V(2-4)	3,830,000	0.0282	26,700	339	8,900	6.1
84707V(5-4)	6,316,000	0.207	66,700	847	17,800	19.6
84707V(1-5)	16,382,000	0.210	111,000	1,410	22,200	20.0

* Maximum extraneous loads and rated torque may be applied simultaneously without damage

Dimensions in English Units

Please note, dimensions subject to change without notice. Contact factory for certified drawings.

MCRT	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"I"	"J"	"K"	"L"	"M"	"O"	"P"
8_002V	8.484	5.500	0.813	1/4-20 X 1/2 DP	Ø0.266 THRU. Ø0.438 X 1.738 DP CBORE	Ø3.625	Ø6.375	8.938	Ø4.375	0.125	2.500	1.375	0.188	Ø 3.1246 3.1241	Ø 3.1257 3.1250
8_004V	7.891	5.500	0.813	7/16-14 X 7/8 DP	Ø0.453 THRU. Ø0.719 X 2.375 DP CBORE	Ø5.625	Ø8.875	10.188	Ø6.875	0.250	3.500	2.313	0.313	Ø 4.8744 4.8737	Ø 4.8760 4.8750
8_007V	7.251	5.625	0.750	3/4-10 X 1-1/32 DP	Ø0.766 THRU. Ø1.188 X 3.289 DP CBORE	Ø9.000	Ø12.875	12.188	Ø10.875	0.250	4.578	3.226	0.313	Ø 7.4994 7.4986	Ø 7.5012 7.5000



Dimensions in SI Units

Please note, dimensions subject to change without notice. Contact factory for certified drawings.

MCRT	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"I"	"J"	"K"	"L"	"M"	"O"	"P"
8_002V	215.49	139.70	20.65	1/4-20 X 12.70 mm DP	Ø6.76 THRU, Ø11.13 X 44.15 DP C'BORE	Ø92.08	Ø161.92	227.03	Ø111.12	3.18	63.50	34.92	4.78	Ø 79.365 79.352	Ø 79.393 79.375
8_004V	200.43	139.70	20.65	7/16-14 X 22.22 mm DP	Ø11.51 THRU, Ø18.26 X 60.32 DP C'BORE	Ø142.88	Ø225.42	258.78	Ø174.62	6.35	88.90	58.72	7.95	Ø123.810 123.792	Ø123.850 123.825
8_007V	184.94	142.88	19.05	3/4-10 X 26.42 mm DP	Ø19.46 THRU, Ø30.18 X 83.54 DP C'BORE	Ø228.60	Ø327.02	327.02	Ø276.22	6.35	116.28	81.94	7.95	Ø190.485 190.464	Ø190.530 190.500