CALIBRATION BEAMS & WEIGHTS

Designed to remove potential sources of measurement error, these beams can be used to calibrate Norbar torque transducers, and torque transducers from other manufacturers (where design permits), as well as mechanical test devices. A UKAS accredited calibration certificate for the measurement of the torque radius is provided with each beam. Note: A temperature controlled environment is essential for use of these beams. The selection of weights will be influenced by gravitational constant at the proposed laboratory site.

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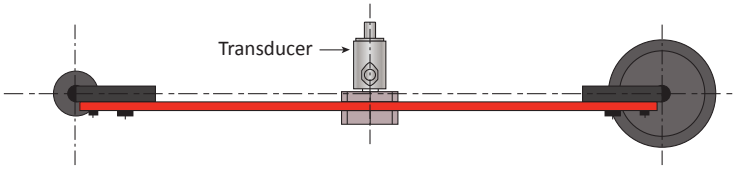
CALIBRATION BEAMS & WEIGHTS - PRINCIPLES OF OPERATION

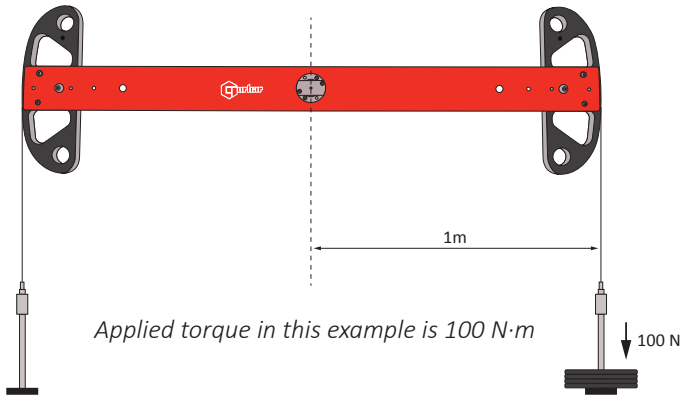
Norbar's test beams are designed for the static calibration of torque transducers. They are ideally suited to Norbar's transducers, but can be employed on other manufacturer's equipment.



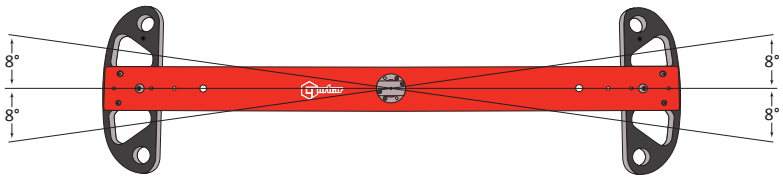
Torque is generated by the application of a known force at a known radius from the centre of rotation of the torque transducer.

The beams are designed with square drives machined to the top limit of ISO 1174. This minimises any play between the beam and the transducer. However, a combination of square drive tolerances, misalignment of fittings and elastic rotation of the transducer shaft inevitably cause the beam to rotate from the horizontal under load.

Norbar's radius ended beams are designed with a ±8˚ usable arc. Using the full 8˚, calibrations to a best class of 0.5 can be carried out. With the additional use of Transducer Calibration Fixtures and 3° Angled Plate (see page 125), a best class of 0.1 can be achieved.



Applied torque in this example is 100 N·m



Additionally, the beams are designed to apply load on a vertical plane which cuts through the square drive inside the transducer. This minimises bending moments on the transducer and for safe operation, ensures that the beam will not fall out of the transducer.

Gravitational Effects

It is very important that the gravitational value for the laboratory is established. The effect of not doing this could be a variation in the force produced by the weight of perhaps 0.5% of reading.

It is therefore strongly recommended that you establish the local value of gravity (g) for your laboratory and use weights that have been calibrated at that gravitational constant.

Norbar will supply weights calibrated to gravitational constants specified by the customer. However, if the customer does not specify a value for 'g' they will have been calibrated at an estimated gravitational constant for the customers' location.

Buoyancy Effects

The Norbar system uses calibrated weights to generate a downwards force.

This means that Archimedes' principle applies, ie. air pressure under the weights causes an upwards force. This reduces the effective force generated by the weights and therefore the mass must be increased to allow for this.

Under standard conditions (i.e. air density 1.2 kg/m3 and 20° centigrade and working in conventional mass terms) the increase required is by a factor of 0.015%.

Weights purchased from Norbar will already have this factor taken into account.

Weights that are calibrated to standard procedures do not have this factor taken into account because the air buoyancy affects both sides of the mass balance and can be ignored. It is important that weights used for torque transducer calibration are adjusted for air buoyancy.

It should also be noted that the double ended beam design employed by Norbar means that each half of the beam is balanced with regard to buoyancy of the beam. This is a significant advantage over single-arm counterbalanced systems.

CALIBRATION BEAMS & WEIGHTS - METRIC

Calibration details

9	METRIC - NEWTON METRE SIZES	
21400	3 N·m	Torque Radius Disc (100 mm)
21429	60 N·m	Radius Ended Beam (0.25 m)
21421	150 N·m	Radius Ended Beam (0.5 m)
21427	500 N·m	Radius Ended Beam (0.5 m)
21428	1,500 N·m	Radius Ended Beam (1.0 m)
21842	7,000 N·m	Free Standing Beam

With the exception of 21842 all calibration beams are supplied in a protective case. A UKAS accredited calibration certificate for the measurement of the torque radius is provided with each beam.

9	WEIGHTS FOR THE DISC 21400
21452.NAM	Brass weight set to give 0.5 N·m (10 x 0.5 N)
21450.NAM	Brass weight set to give 1.0 N·m (10 x 1.0 N)
21479.NAM	Brass weight set to give 2.5 N·m (10 x 2.5 N)

9	WEIGHTS FOR THE BEAM 21429
21476.NAM	Cast iron weight set to give 5 N·m (10 x 2 N)
21454.NAM	Cast iron weight set to give 10 N·m (10 x 4 N)
21458.NAM	Cast iron weight set to give 50 N·m (10 x 20 N)
Q2343.NAM	Cast iron weight set to give 60 N·m Optimised for the Pro-Test 60 (1 x 4.8 N, 1 x 7.2 N, 1 x 12 N, 1 x 24 N, 4 x 48 N)

9	WEIGHTS FOR THE BEAM 21421
21477.NAM	Cast iron weight set to give 50 N·m (10 x 10 N)
21458.NAM	Cast iron weight set to give 100 N·m (10 x 20 N)

9	WEIGHTS FOR THE BEAM 21427/21428
21459.NAM	Cast iron weight set to give 250/500 N·m (1 x 10 N, 10 x 50 N)
21460.NAM	Cast iron weight set to give 500/1,000 N·m (1 x 10 N, 10 x 100 N)
21483.NAM	Cast iron weight set to give 500/1,000 & 1,500 N·m (14 x 100 N, 1 x 50 N, 2 x 20 N, 1 x 10 N)

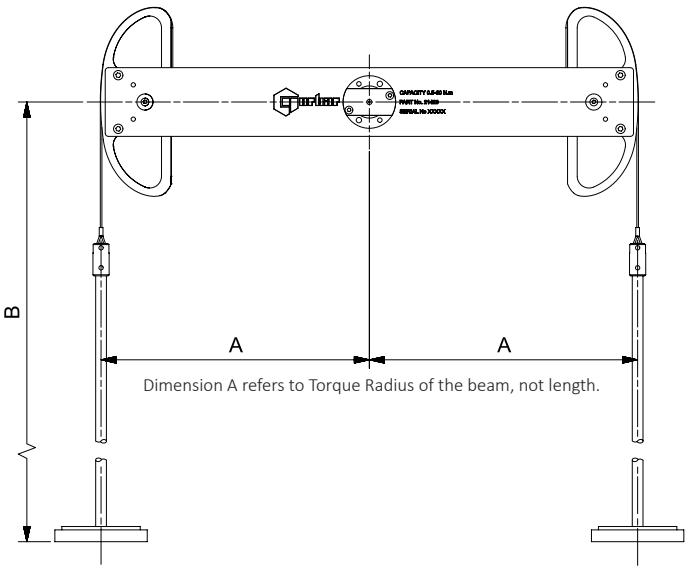
e.g. set 21459.NAM will give 250 N·m on a 21427 beam and 500 N·m on a 21428.

9	WEIGHTS FOR THE BEAM 21842
21469.NAM	Cast iron weight set to give 7,000 N·m (20 x 50 lbf)

All weight sets come with traceable UKAS accredited calibration certificate. This requires the customer to provide the value for 'g' (local gravity) for the intended place of use when ordering.

Model		100 mm Disc	0.25 m Beam	0.5 m Beam	0.5 m Beam	1 m Beam	Free Standing Beam
Part Number		21400	21429	21421	21427	21428	21842
Minimum Torque (N·m)		0.05	0.5	5	50	10	350
Dimensions (mm)	A	100	250	500	500	1,000	* 1,573.66
	B max.	295	650	755	1,015	1,015	1,070
Weight (kg)		0.5	1.9	5.0	17.0	25.0	270.0

* A max. Torque Radius for 7,000 N·m beam



CALIBRATION BEAMS & WEIGHTS - IMPERIAL

Calibration details

9	IMPERIAL - POUNDS FEET SIZES	
21400	25 lbf·in	Torque Radius Disc (100 mm)
21430	500 lbf·in	Radius Ended Beam (10")
21424	100 lbf·ft	Radius Ended Beam (12")
21425	500 lbf·ft	Radius Ended Beam (24")
21426	1,000 lbf·ft	Radius Ended Beam (48")
21842	5,000 lbf·ft	Free Standing Beam

With the exception of 21842 all calibration beams are supplied in a protective case. A UKAS accredited calibration certificate for the measurement of the torque radius is provided with each beam.

9	WEIGHTS FOR THE DISC 21400
21455.NAM	Brass weight set to give 50 ozf·in (10 x 1.27 ozf)
21453.NAM	Brass weight set to give 100 ozf·in (10 x 2.54 ozf)
21451.NAM	Brass weight set to give 160 ozf·in (10 x 4.064 ozf)

9	WEIGHTS FOR THE BEAM 21430
21465.NAM	Cast iron weight set to give 100 lbf·in (10 x 1 lbf)
21466.NAM	Cast iron weight set to give 500 lbf·in (10 x 5 lbf)

9	WEIGHTS FOR THE BEAM 21424
21467.NAM	Cast iron weight set to give 100 lbf·ft (10 x 10 lbf)

9	WEIGHTS FOR THE BEAM 21425
21468.NAM	Cast iron weight set to give 500 lbf·ft (10 x 25 lbf)

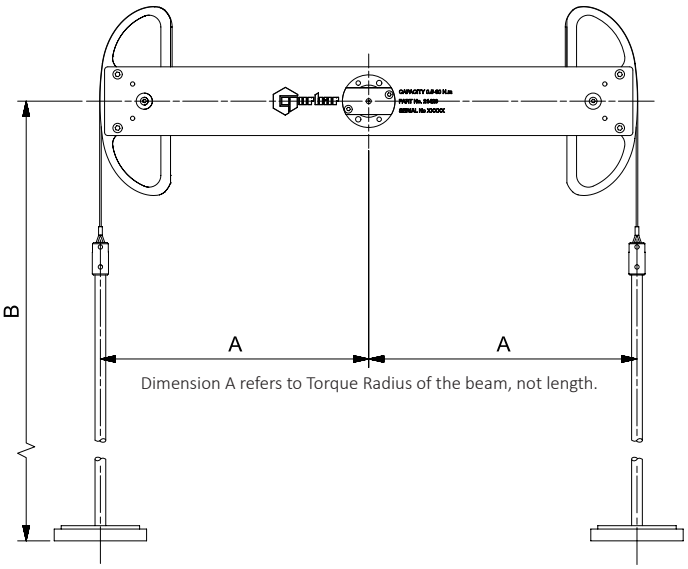
9	WEIGHTS FOR THE BEAM 21426
21468.NAM	Cast iron weight set to give 1,000 lbf·ft (10 x 25 lbf)

9	WEIGHTS FOR THE BEAM 21842
21469.NAM	Cast iron weight set to give 5,000 lbf·ft (20 x 50 lbf)

All weight sets come with a traceable UKAS accredited calibration certificate. This requires the customer to provide the value for 'g' (local gravity) for the intended place of use when ordering.

Model		100 mm Disc	10" Beam	12" Beam	24" Beam	48" Beam	Free Standing Beam
Part Number		21400	21430	21424	21425	21426	21842
Minimum torque		0.44 lbf·in	10 lbf·in	10 lbf·ft	50 lbf·ft	100 lbf·ft	300 lbf·ft
Dimensions (mm)	A	100	254	305	610	1,219	* 1,524
	B max.	295	650	690	965	1,015	1,070
Weight (kg)		0.5	1.2	3.7	17.3	26.4	270.0

* A max. Torque Radius for 5,000 lbf·ft beam



Dimension A refers to Torque Radius of the beam, not length.

9	ANCILLARY PRODUCTS FOR CALIBRATION BEAMS
J2676	1,500 N.m Calibration Pedestal
J2329	Pro-Test Calibration Test Rig Assembly
80005	Adjustable Angle Attachment

9	CALIBRATION FIXTURES
J5042.025	Transducer calibration fixture ¼" sq
J5042.0375	Transducer calibration fixture ⅜" sq
J5042.05	Transducer calibration fixture ½" sq
J5042.075	Transducer calibration fixture ¾" sq
J5042.1	Transducer calibration fixture 1" sq
J3305	3° Angled Plate for use with calibration fixtures

CALIBRATION CERTIFICATES

As a UKAS accredited calibration Laboratory No. 0256, Norbar is required to calibrate torque measuring devices that are within the laboratory's scope, in accordance with BS 7882:2017. See the 'UKAS Schedule of Accreditation' on the 'Calibration Services' page of our website, www.norbar.com.

Norbar can provide a comprehensive range of calibrations including increasing and decreasing torques; clockwise and counter-clockwise; in either SI or English torque units, or in mV/V or Volts.

The sections below summarise the main features of BS 7882:2017, but purchase and careful study of the standard is advised for those who wish to have more detailed information.

Procedure

- The 'device' is defined as all parts of a system, e.g. Display, Transducer cable and Transducer. Transducer cables will therefore be serial numbered if they are separate items.
- The output of the device is defined as 'deflection'.
- It is preferable to calibrate all parts of a system together. If a transducer is sent for calibration without its normal display unit, an equivalent calibrated display held in the laboratory will be used. The normal display must also be in a calibrated state or the certification for the transducer is invalidated.
- Norbar is currently the only laboratory accredited by UKAS for the calibration of Electrical Torque Measuring Indicators.
- Before any calibration or recalibration the torque measuring device is preloaded three times in succession to the maximum applied torque of the device. Each preload is maintained for a minimum of 30 seconds to exercise the device and stabilise it in the calibration fixture.
- The device is calibrated with at least five approximately equal steps from 20% to 100% of maximum torque. Lower values are allowed as long as they meet certain criteria for resolution.
- For classes 0.05 and 0.1, it is mandatory to calibrate the torque measuring device in four different mounting positions each rotated 90° about the measurement axis. For all other classes the device is calibrated at a minimum of two different mounting positions at least 90° apart.
- Two series of readings are taken, and the device is then disturbed, generally by being disconnected from the calibration fixture and rotated through 90°. The device is then preloaded once to full scale. A third series of readings are then taken. This process is repeated until readings have been recorded in all required orientations.
- If reversibility is required, a single series of decreasing torques are applied at the end of the last increasing series.
- Should calibration be required in both directions, the series of readings are repeated in the opposite direction.
- The calibration data is then analysed to establish the following parameters.

Repeatability

The variation between the indicated deflection from series 1 and 2, expressed as a percentage of the mean of the two readings.

Reproducibility

The maximum variation between series 1, 2 and 3, or series 1, 2, 3, 4 and 5 expressed as a percentage of the mean indicated deflection calculated from series 1, 3 or series 1, 3, 4, and 5.

Error of Indication

Where the results are expressed in units of torque, the errors of indication are the variation between each applied torque and the mean indicated deflection at that torque.

Error of Zero Torque

The maximum zero reading recorded after each loading series is expressed as a percentage of the maximum mean indicated deflection.

Error of Interpolation

Where the results are expressed in volts or units other than torque units, a second order polynomial equation (best fit line) is established and the difference in deflection from the computed value is expressed as a percentage of the computed value.

Reversibility

The variation between the readings from the last torque series applied in an increasing mode and the readings for the same given torque applied in a decreasing mode. Reversibility is expressed as a percentage of the deflection of the last increasing series for the given torque.

Classification

- The parameters are each compared with a table to establish the device's classification. Class 0.05 is the highest performance, and class 5 is the lowest defined by the standard. The overall class reported will be that of the lowest performing parameter. For example reproducibility may be a class 1 when all other parameters meet class 0.5. The device will be classified as 1.
- Additionally the uncertainty of measurement of the applied torque must be five times better than the overall class reported. Norbar's uncertainty of measurement (typically 0.02%) allows classification to Class 0.1 devices.
- Different classes may be quoted for ranges below 20% of maximum capacity.

Relative Measurement Uncertainty Interval

The relative measurement uncertainty interval of the device is also calculated by combining the relative mean deviation with the relative expanded uncertainty.

Effectively the uncertainty interval encompasses all of a transducers reported errors and uncertainty of calibration, providing the user with a maximum error value of the calibrated device.

Accredited calibrations performed to BS 7882:2017 meet the requirements of BS EN ISO6789-2:2017 clause 4.3 and annex C 7.3, and BS EN ISO 6789-1:2017 clause 6.1.