OPERATOR'S MANUAL

Norbar Torque Tools

5000 lbf·ft / 5000 N·m CALIBRATION MACHINE MODEL 21515

Part Number 34190 | Issue 2 | Original Instructions (English)

CONTENTS

SAFETY

It is recommended that safety shoes are worn. Use safe manual handling techniques when lifting.

INTRODUCTION

To meet the increasing demand for certification equipment the 5000 lbf·ft test beam has been developed.

The beam and its associate stand have been robustly constructed to ensure only torque is applied to the transducer under test, minimising loss of torque (through bending or bearing loss) to the device being tested.

The whole apparatus being free standing.

A self locking gearbox provides an easy method of aligning the beam once loaded.

The beams and iron weights are guaranteed within a tolerance of accuracy and traceable certification provided.

Weight Sets Available

Weight Set Part Number	Set Comprises Of	Weight Hanger Position	Nominal Radius	Test Range
21462	20 x 20 kg	B	1274.6 mm	5000 N·m @500 N·m steps
21469	20 x 50 lbf	A	1524 mm (5 ft)	5000 lbf·ft @ 500 lbf·ft steps
		C	1124 mm	5000 N·m @500 N·m steps

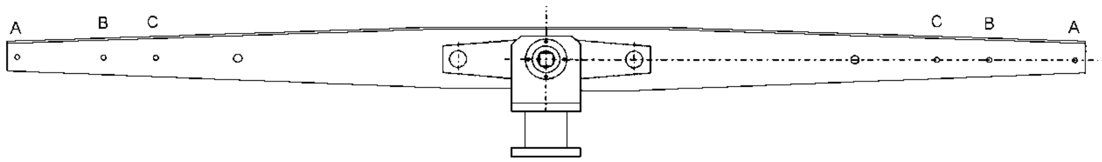


FIGURE 1 – Weight Hanger Position

PRINCIPLE OF OPERATION

A known torque is applied to the transducer to be calibrated by the principle of a known force (weights) applied at a known distance (on a beam) from the centre of rotation of the torque transducer under test. Reaction is taken at the other end of the transducer via a reaction plate fixed to a bed. The beams and bearing housing assembly are also fixed to this bed; the whole assembly being fixed to a pedestal base. Both clockwise and anti-clockwise calibration is available, (the beams are symmetrical).

Torque = Force x distance (can be applied through either beam).

Force = Weight applied.

Distance = Distance from point at which load is applied to centre of rotation of transducer.

EXTERNAL EFFECTS

Temperature Compensation

All Norbar test beams should be used in a temperature controlled environment of 20 degrees C +/- 2 degrees C.

If the beam must be used outside these limits, the temperate must be stable (within 1 degrees C change per hour) and the effective length of the beam calculated according to the details below.

The temperature coefficient for steel is 12 x 10^{-6}/degrees C.

The formula for calculating the effective beam length at any given temperature away from 20 degrees C is:

Radius of beam x Coefficient of Expansion x Change in temperature in degrees C from 20 degrees nominal.

Example: A nominally 1 metre radius beam at 24 degrees C has and effective increase in length of 1.00000 x 12 x 10^{-6} x 4. The new length is therefore 1.000048 metres.

Gravitational Effects

It is very important that the gravitational value for the Laboratory is established. The effect of not doing this in the UK could be a variation in the force produced by the weight (masses) of up to approximately 0.05%, which is five times the 0.01% tolerance of the weight. Outside the UK this variation in force could be significantly more.

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 the standard UK gravitational constant of 9.81500 m/s^2. As already noted this figure is subject to approximately 0.05% variation across the UK.

Buoyancy Effects

The Norbar system uses calibrated masses to generate a force downwards. It differs from mass balances where masses are compared like with like, because the masses are compared with transducers.

This means that Archimedes principle applies which means there is a force upwards on the masses caused by air under them. This force reduces the effective force generated by the masses and they should be increased to allow for this.

Under standard conditions, (ie. air pressure 1.2kg/m^3 and 20 degrees centigrade) and working in conventional mass terms the increase required is by a factor of:

$$\frac{1}{(1 - 1.2 / 8000)}$$

For example, assuming that the masses are being calibrated on a mass balance, instead of being adjusted to show an effective force of 1.00000 Newtons, they should show an effective force of:

$$1 \left(\frac{1}{(1 - 1.2 / 8000)} \right) = 1.00015 \text{ Newtons}$$

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

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.

SET UP INSTRUCTIONS

NOTE: Refer to General Assembly Drawings Number 21515, sheets 1 and 2, for item numbers contained in detailed assembly procedures.

Assembly Instructions are grouped under the four headings listed, and assembly should follow in the sequence of the headings listed.

1) Base unit
2) Centre pivot & beam
3) Geared head
4) Weight carriers
5) Initial Balance of Beam

Assembly Tools: No special tools are required for assembly, one spanner size for hex bolts, + Allen keys, Spanner size: A/F 19 mm. Allen keys: $^{3}/_{32}$" A/F, 5 mm A/F, 6 mm A/F, and 19 mm A/F.

To facilitate proper assembly, major component joints are colour coded, ie. a yellow dot will correspond to another yellow dot.

Base Unit

1.1 Ensure area for assembly is flat and clean, and of composition to bear the weight of the assembled unit, (360 Kg).

1.2 Join the two base sections (item 2) using connection plate (item 5) extended foot (item 6) and eight screws (item 15). Do not fully tighten screws at this stage.

1.3 Attach centre column to mid-position of base sections, using four screws (item 16). Do not fully tighten screws at this stage.

1.4 Attach support struts (item 3) to centre column and base sections using four sets of bolts, washers and nuts (items 12, 13 and 14).

1.5 Ensuring centre column is vertical, tighten all screws and bolts.

1.6 Position top slide (item 7) and attached pre-assembled centre pivot, ensuring overhang of top slide is above extended foot. (item 6). Secure with six screws (item 16) and fully tighten.

1.7 Six holes are provided in the base members for securing to the floor. Prior to securing, the top slide, now fitted, must be levelled by means of the jacking screw provided in the extended foot.

Satisfactory indication of the axial level of the centre pivot may be obtained by application of a suitable spirit level, to the top face of either of the machined edges of the top slide. This is essential for the proper working of the test beam.

Centre Pivot and Beam

2.1 The centre pivot and beam assembly is constructed from three main components, i.e. the pre-assembled centre pivot, and two half beams.

2.2 The centre pivot assembly is shown on drawing 21515, sheet 2.

2.3 The beam halves are fitted to the centre pivot individually. The semi-circular notch formed in the inner end of each half beam locates on the circumference of the inner step of the centre pivot collar (item 12).

2.4 Using the features described, locate one half beam inner end onto inner step of collar (item 12); the inner end side faces of the beam are now contained between the raised central diameter of collar (item 12) and centre plate (item 5); the fitting clearance being finally removed as described in paragraph. 2.12.

2.5 Align ∅ 50 holes in beam and centre plate (item 5) and fit insert (item 6).

2.6 Fit side cap (item 7) to bolt (item 15) ensuring plain face of cap is facing head of bolt.

2.7 Fit shank of bolt (item 15) through insert (item 6) and fit second side cap, plain face towards nut end of bolt.

2.8 Attach nut (item 16) but do not spanner tighten at this stage.

2.9 Repeat stages 2.3 to 2.8 inclusive.

2.10 The combining of the two half beams may now be completed by inserting screws (item 20) into connecting blocks, as shown in left hand view on drawing 21515, sheet 2, noting that all screws are applied from one side.

2.11 Fully tighten screws in diagonal sequence.

2.12 The beam fitting clearance must now be removed by tightening screws (item 23) until raised central diameter of collar (item 12) is seen to butt onto side face of beam.

2.13 Fully tighten bolt and nut (items 15 and 16) on both halves of beam.

Geared Head

The geared head used for applying torque is supplied as a fully assembled unit, and requires only to be fitted to the top slide now part of the base assembly.

3.1 The sliding reaction plate fitted to the geared head incorporates two opposed parallel slots.

3.2 Engage slots with top plate and slide into approx. mid position on top slide, with square drive input facing beam.

Weight Carriers

4.1 Referring to drawing 21515, sheet 1, fit yoke hanger (item 8) complete with yoke and weight carriers to both ends of beam using bolt (item 17) and nut (item 18).

4.2 Place weight platform (item 11) immediately under weight carrier at end of beam required to be loaded.

Initial Balancing Of Beam

5.1 Each set of beam components has been pre-delivery checked for correct assembly and balance.

5.2 After re-assembly, each beam must be re-checked for balance before being passed for loaded operation.

5.3 A trimming weight incorporated in the beam assembly has been adjusted during the pre-delivery check to provide accurate balance of the beam, but re-assembly may effect the initial balance, correction must be then made by addition or subtraction to the trimming weight.

NOTE: The weight is found bolted to one of the additional holes on the beam plate.

CALIBRATION PROCEDURE

1. The force centre distance of the test beam is constant, and the applied torque can only be varied by weights applied to the weight carriers.

2. The twin weight carriers must be loaded equally, i.e. the weight carriers must not be used singly.

3. Before loading weights onto weight carriers, place weight platform in position.

4. Attach required weights to weight hangers.

5. Dependent on transducer to be employed fit appropriate adaptors to gearbox output and to input square of bearing assembly. Do not engage transducer with beam at this stage.

6. Connect torque transducer to be calibrated to ETS and plug in amplifier. Allow 5 minutes for instrument to stabilise.

7. Zero amplifier. Mate transducer with beam adaptors.

8. Apply torque to beam by winding gearbox handwheel until the instruments registers a minimum of 100% of full scale, and weights are seen to be clear of weight platform.

9. Decrease torque until ETS reading is at a minimum and weights are firmly seated on weight platform.

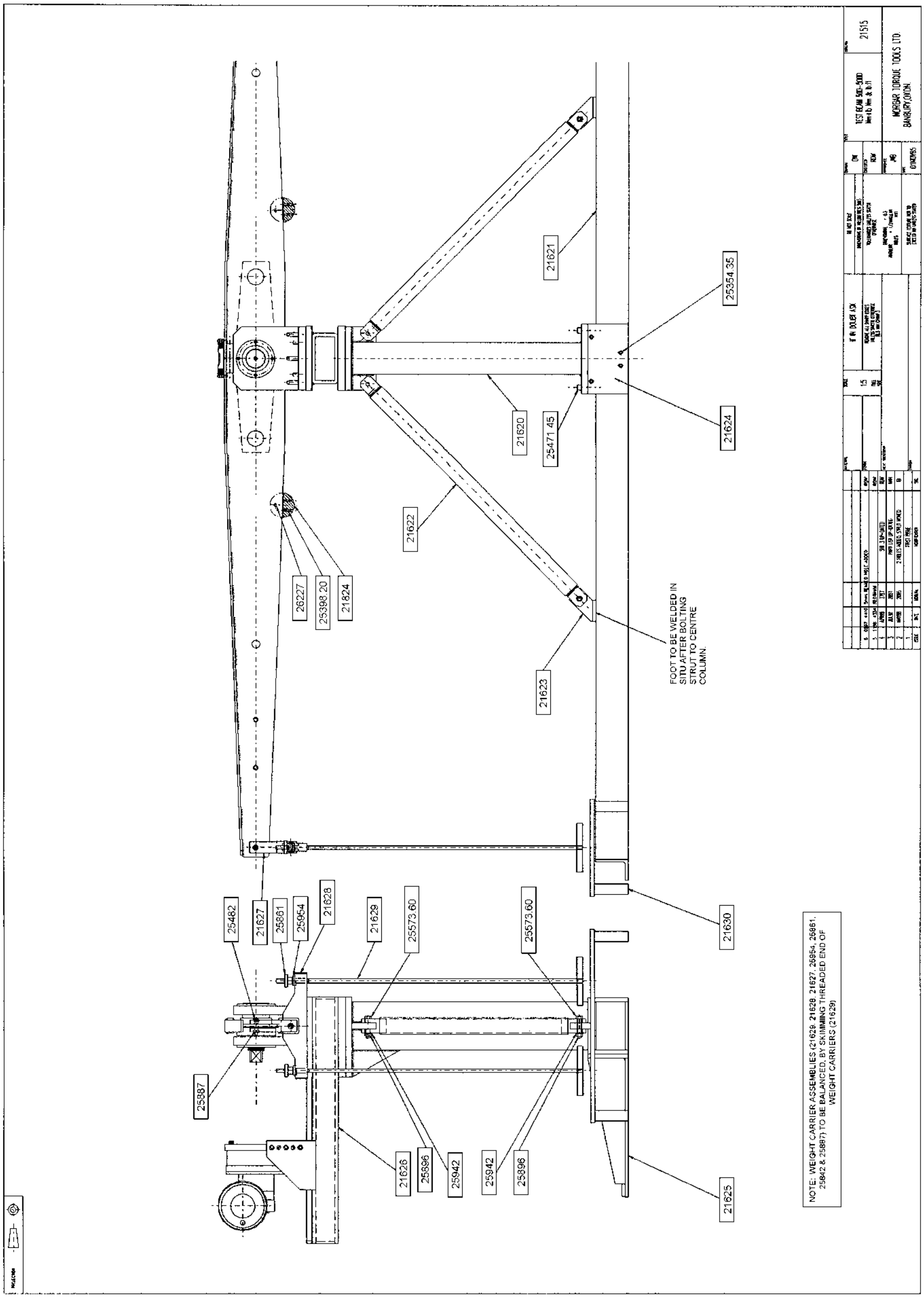
10. Repeat (8) and (9) 3 times, release load, and zero amplifier.

11. Apply full load and level beam using visual indication of built in spirit level, and apply gearbox lock.

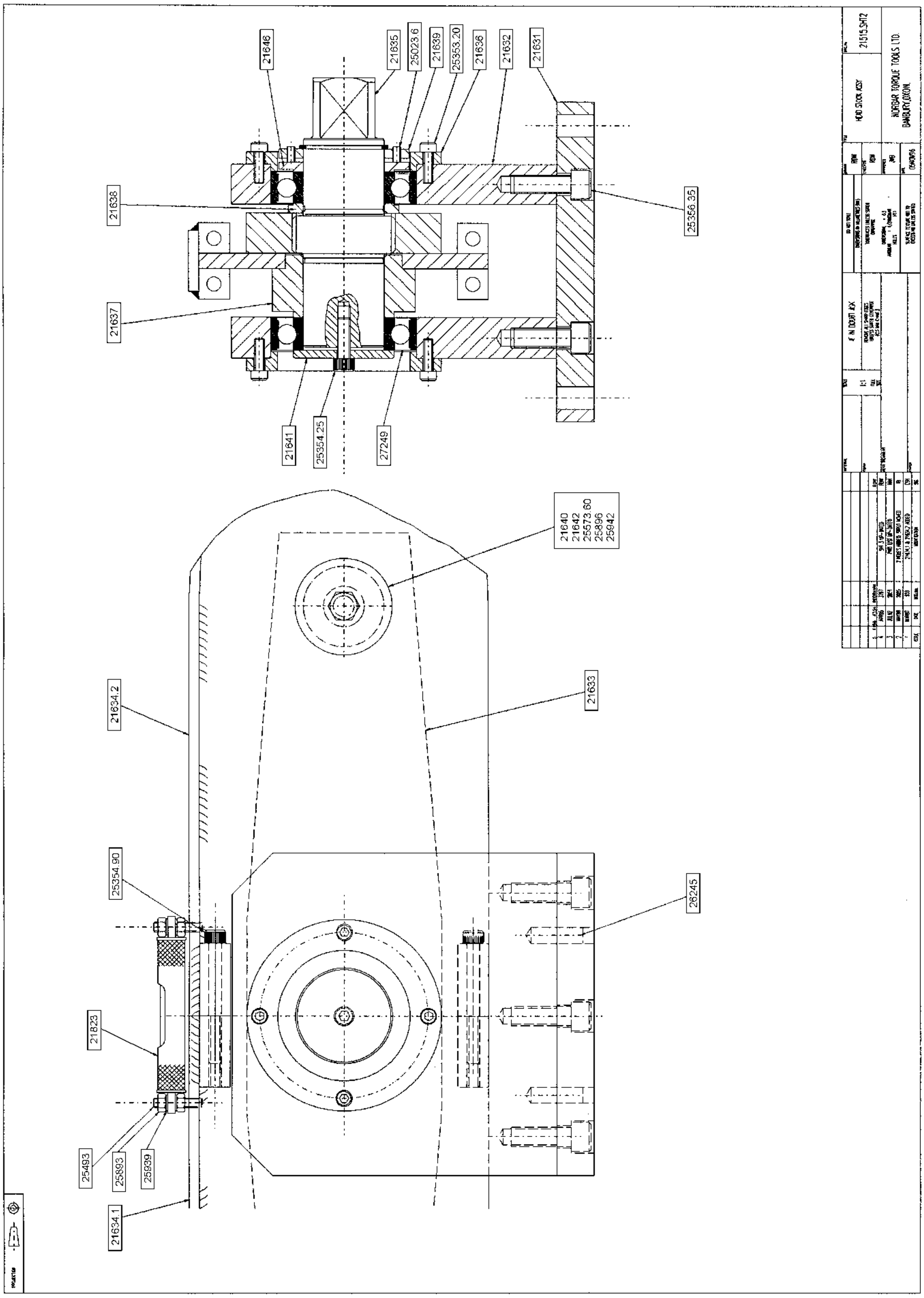
12. Take 10 incremental readings at 10% intervals up to full load, levelling the beam at each increment, and waiting each time for reading to stabilise. Varying readings are caused by movement of the weights and beam fixture.

13. For reverse calibration repeat (7) to (12), but apply weight on opposite end of beam.

5000 lbf·ft TEST BEAM ILLUSTRATION DRG NO. 21515, SHEET 1



5000 lbf·ft TEST BEAM ILLUSTRATION DRG NO. 21515, SHEET 2



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