



HANDTORQUE® TORQUE MULTIPLIERS

Torque wrench design offers just two solutions to the challenge of applying higher torques: either the load at the handle must be higher or the lever length must be greater. Clearly there are practical and safety limits to both of these solutions. For example, a Norbar model 1000 (1,000 N·m) torque wrench is 1.7 m long with the extension handle fitted. As this is already quite long, how would one apply 2,000 or 3,000 N·m? Often there will not be the space to operate a torque wrench of sufficient length to comfortably apply such high torques and the chance that the wrench might slip off the nut increases as length increases.

Norbar's solution is to use a compact, epicyclic gearbox called a HandTorque® multiplier to accurately multiply the input torque provided by a torque wrench by a fixed ratio. This fixed ratio might be in the order of 5:1, 27:1 or even up to 135:1 for very high torque application. This means that a much smaller torque wrench can be used for a given torque application and the combined weight of the torque multiplier and torque wrench will often be lower than for a single large torque wrench. For example, one could apply 1,000 N·m using a Norbar Model 1000 torque wrench weighing 5.8 kg or an HT-52/22.2 combined with a NorTorque® 60 with a total weight of just under 2 kg and a lever length of just 310 mm.

The Norbar HandTorque® multiplier range is the most comprehensive available. Standard products are available up to 47,500 N·m (35,000 lbf·ft) and 'specials' to 300,000 N·m (220,000 lbf·ft). A range of 'nose extensions' for reaching difficult to access bolts and a full range of torque transducers for highly accurate torque monitoring are available.

Torque Reaction	39
HandTorque Torque Multipliers	41
Anti Wind-Up Ratchets (AWUR)	43
HandTorque® HT3-1000	44
HandTorque® HT3 Series	44
HandTorque® HT4 Series	45
HandTorque® Compact Series	46
HandTorque® Compact Series Kits	47
HandTorque® Standard Series	47
HandTorque® Small Diameter Series	49





TORQUE REACTION

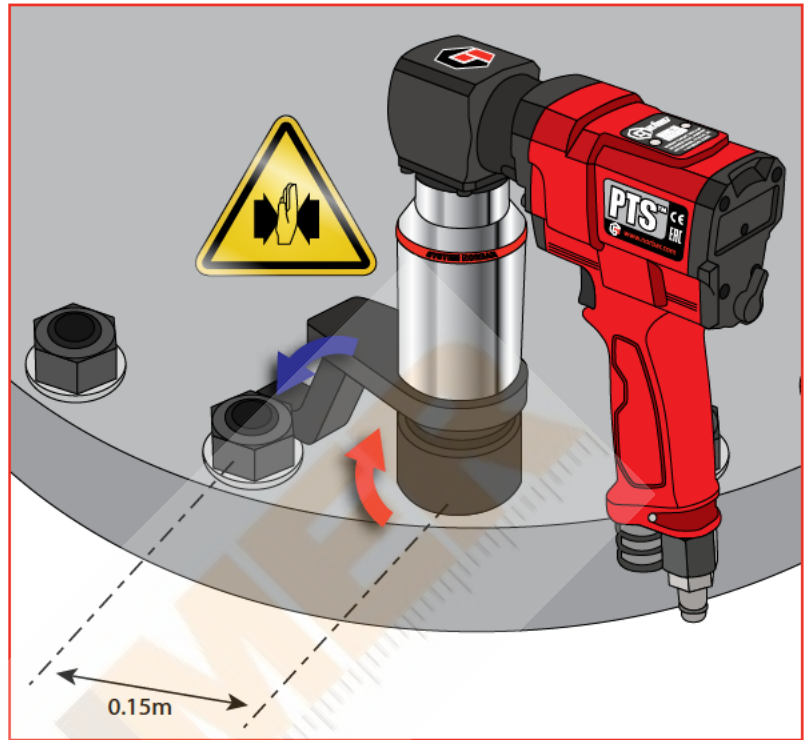
This page applies to both HandTorque® multipliers and powered torque tools

Principles of Torque Reaction

Newton's law dictates that for every applied force there is an equal and opposite reactive force. For applications requiring relatively low torques that can be applied with a torque wrench, this does not present a problem as the reactive force is absorbed by the operator. However, if the desired torque necessitates the use of a multiplier, the resultant reactive force can only be absorbed using an appropriate reaction device.

For this reason all Norbar multipliers are supplied with a reaction plate or reaction foot fitted as standard.

All of the standard reaction plates and feet supplied with standard Norbar tools have been designed to enable the multiplier's use in a variety of environments. However, due to an infinite number of bolting arrangements, it is impossible to have one reaction device that will satisfy every customer's requirement. See page 70 for when the supplied standard reaction is not suitable.



In the above example, 1,000 N·m torque output will result in a reactive force of 6,667 N at a point 0.15 m from the axis of rotation or 2,000 N at 0.5 m.

Avoiding Torque Reaction Problems

It has already been mentioned that the reaction force is equal to the force being applied. However, the magnitude of the reaction force is dependent upon the perpendicular distance between the point of reaction and the centre line of the multiplier, ie. the greater the distance the lower the force.

For this reason the point of reaction should be kept as far away from the centre line of the gearbox as is practical.

Customers using or modifying reaction plates for Standard Series multipliers up to a capacity of 3,400 N·m should note that if the reaction is taken on the radiused part, the reaction force is perpendicular to the tangent of the curve. Consequently, the further around the radius the reaction is taken, the smaller the perpendicular distance and therefore the greater the force.

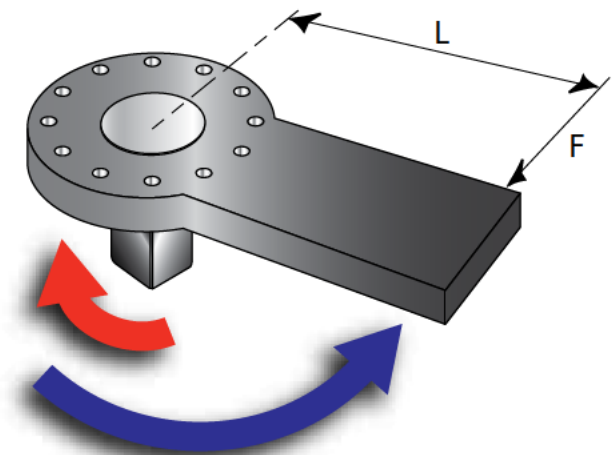
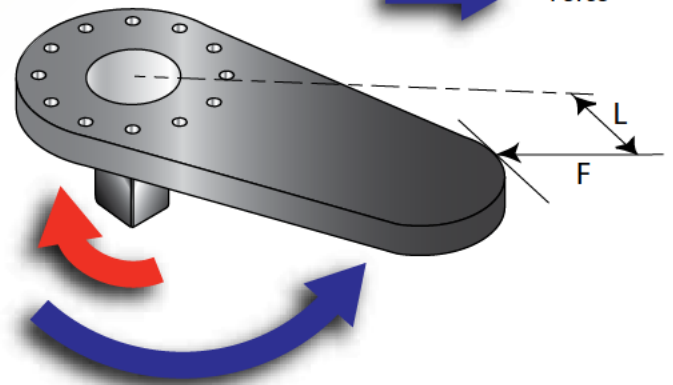
Although a longer reaction plate may mean lower forces, the bending moment close to the multiplier will increase.

Customers extending the length of Norbar's standard reaction plates should be aware that an increase in overall length will result in a larger induced bending stress and should not assume that because the reaction plate is strong enough at one length it will remain so when extended.

Excessive side loading, resulting from poor reaction, increases frictional forces inside the multiplier. This can lead to lower multiplication ratios (outside ±4%).

The ideal reaction arrangement has the centre of the reaction bar and the centre of the nut on a perpendicular line to the centre line of the tool.

$$\text{Force} = \frac{\text{Torque}}{\text{Length}}$$





TORQUE REACTION

This page applies to both HandTorque® multipliers and powered torque tools



*Red shading indicates ideal area for torque reaction.
It is not advised to react outside of the shaded area.*



*Signs of poor reaction are evident on this damaged foot.
Reaction was taken at the wrong point on the foot and burring indicates that the foot was slipping off the reaction point.*

Points to remember

- Take the reaction as far away from the multiplier as practical
- Ensure that the reaction point remains square to the multiplier wherever possible as this will minimise any additional stress in the output square, which could result in premature failure. If the multiplier tilts under load, the reaction may not be square
- For applications that do not allow the reaction to be taken securely it is advisable to use a double-sided or balanced reaction plate

Reaction Force

When using multipliers and PneuTorques the reaction point must be capable of withstanding the reaction force. Therefore, great care must be exercised where the reaction is taken when applying high torques to studs and bolts.

By using the following formula you can calculate the force at the point of reaction. The greater the distance the lower the force.

D = Stud Diameter

$$\text{Formula to calculate Area of Stud} = \frac{\pi \times D^2}{4}$$

$$\text{Formula to calculate shear force: Shear Force} = \frac{\text{Reaction Force}}{\text{Area of Stud}}$$

What to do if the standard reaction device is not suitable

For those applications that do not permit the use of a standard reaction plate the customer has three options.

- Norbar or an authorised Norbar distributor will design and manufacture a special purpose reaction plate to the customer's requirements
- The customer can modify the standard reaction plate to suit their requirements
- The customer can fabricate their own reaction device after liaison with Norbar's technical department or a Norbar distributor

Customers wishing to either modify the original reaction plate or fabricate their own device should read the above information on how to avoid common torque reaction problems.



HANDTORQUE® TORQUE MULTIPLIERS

What is a Torque Multiplier?

A torque multiplier is a device that increases the torque that can be applied by an operator. This is because the power output cannot exceed the power input, the number of output revolutions will be lower than the number of input revolutions ($\text{Torque} \times \text{rpm} = \text{Power}$).

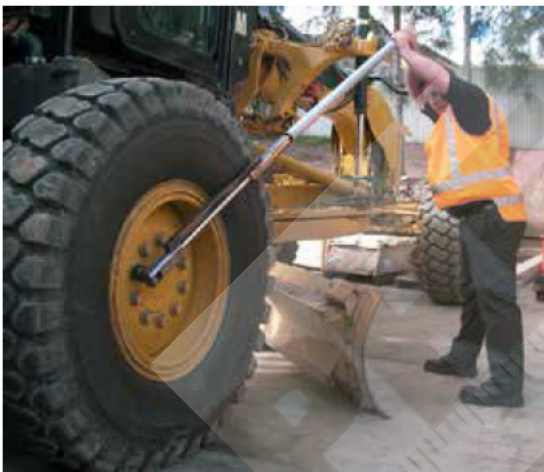
How HandTorque® Torque Multipliers Work

HandTorque® multipliers incorporate an 'epicyclic' or 'planetary' gear train having one or more stages. Each stage of gearing increases the torque applied, allowing Norbar to offer multipliers typically in ratios of 5:1, 27:1 and 135:1.

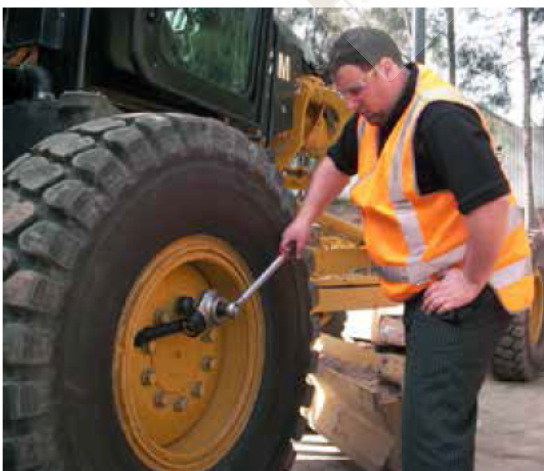
In the planetary gear system, torque is applied to the input gear or 'sun' gear. Three or four planet gears whose teeth are engaged with the 'sun' gear therefore rotate. The outside casing of the multiplier, or 'annulus' is also engaged with the planet gear teeth, and would normally rotate in the opposite direction to the 'sun' gear. A reaction arm prevents the annulus from rotating, and this causes the planet gears to orbit around the 'sun'. The planet gears are held in a 'planetary' carrier which also holds the output square drive, therefore as the planet gears orbit around the sun gear, the carrier and so the square drive turns. Without the reaction arm to keep the annulus stationary, the output square will not apply torque.

Why use a HandTorque® Multiplier?

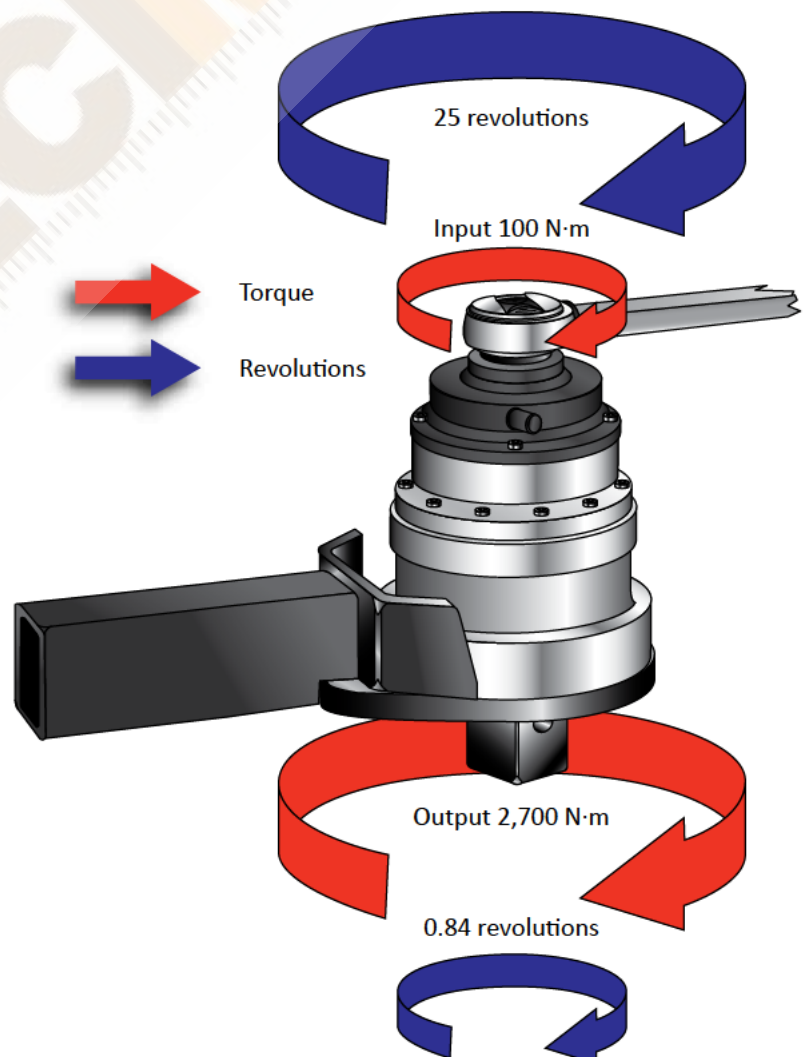
- **Safety** – use of long levers can be dangerous. Torque multipliers allow for a reduction in the lever length or operator effort
- **Space limitation** – the use of a long lever may be impossible due to the available space
- **Accuracy** – torque will be applied most accurately when it is applied smoothly and slowly. Torque multipliers enable this by removing much of the physical effort from the tightening task



Without a torque multiplier



With a torque multiplier



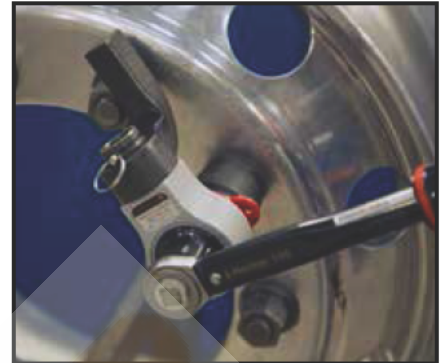


HANDTORQUE® TORQUE MULTIPLIERS

Advantages of the Norbar HandTorque® System

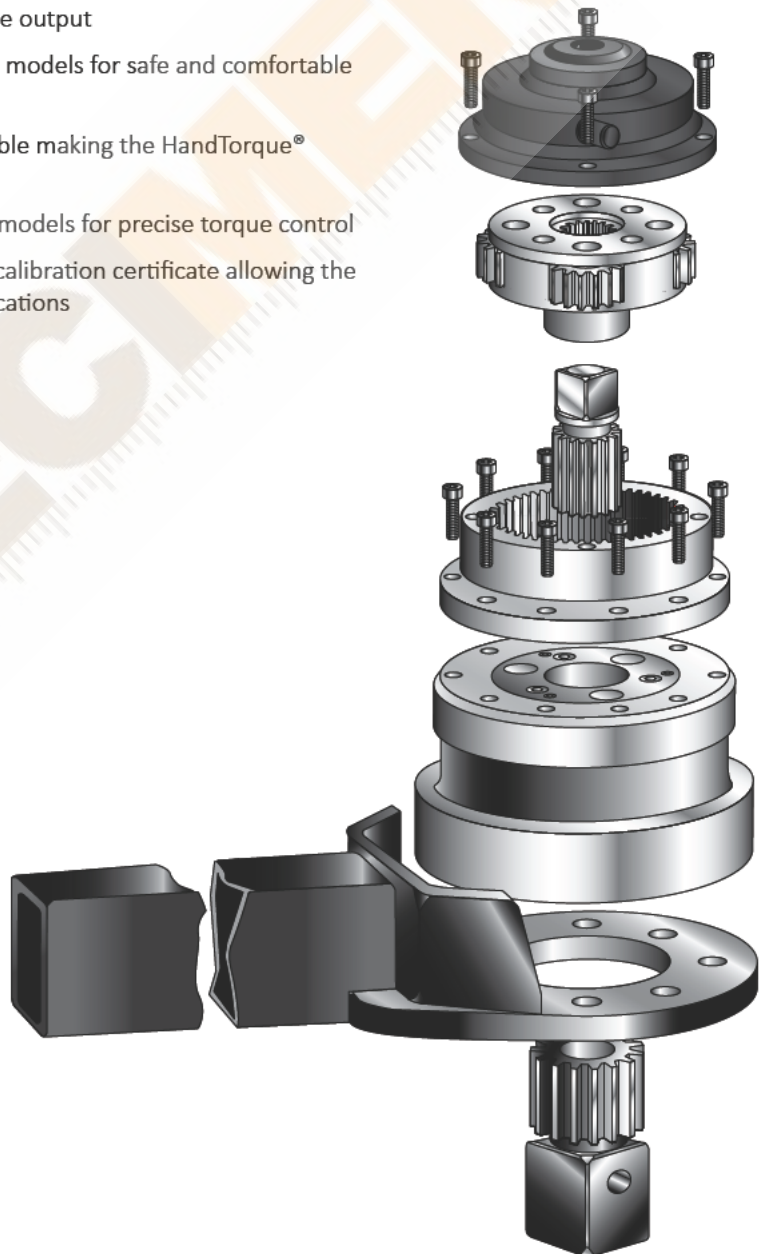
Norbar gearboxes are built to an extremely high standard of precision. All gears rotate on needle roller bearings about hardened and ground journal pins. As a result, Norbar HandTorques can be relied upon to have a mean torque multiplication accuracy of $\pm 4\%$, taking the uncertainty out of high torque tightening.

No gearbox is 100% efficient, and so the velocity ratio (the number of turns that the input has to make to achieve one revolution of the output) is not the same as the torque multiplication ratio. Norbar multipliers are engineered such that each gear stage typically has a nominal 5:1 ratio, this means a velocity ratio of typically 5.45:1 which results in a true torque multiplication factor of 5.2:1.



Summary of Norbar torque multiplier advantages:

- The ratio stated is the true torque multiplication factor
- No correction charts are needed to determine torque output
- Strong, safe Anti Wind-Up Ratchet available on most models for safe and comfortable operation
- A wide range of alternative reaction styles are available making the HandTorque® adaptable to many applications
- Electronic torque transducers are available on most models for precise torque control
- Compact Series are supplied with their own unique calibration certificate allowing the accurate calculation of input torque for critical applications





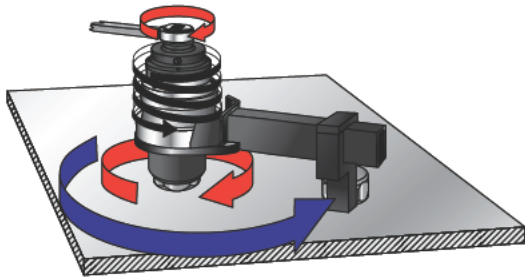
ANTI WIND-UP RATCHETS (AWUR)



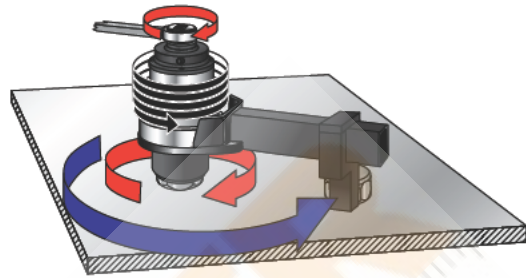
Norbar Anti Wind-Up Ratchets

Most multipliers with ratios of 15:1 and over are fitted with an Anti Wind-Up Ratchet. The multiplier can be thought of as a spring which must be fully wound before any tightening/untightening work can be applied to the bolt.

The AWUR ensures that the 'spring' stays wound and that any further torque input to the multiplier is applied directly to the bolt.



Multiplier behaves like a very stiff 'spring'



Multiplier will achieve maximum torque only after the 'spring' has been taken up



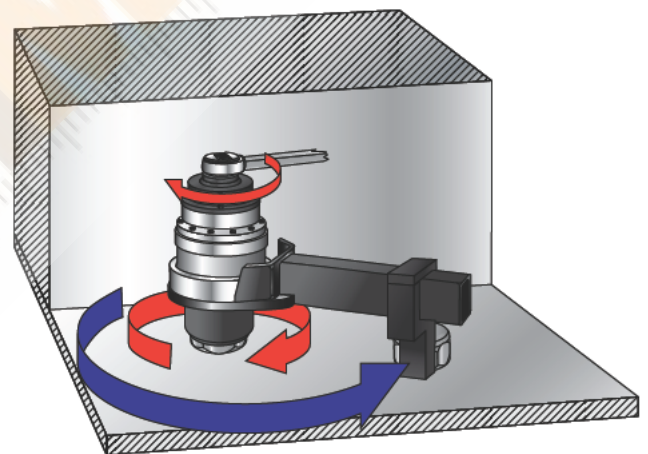
Torque



Reaction Force

AWUR benefits include:

1. The torque input device cannot fly backwards against the direction of operation if it is suddenly released.
2. Without an Anti Wind-Up Ratchet, it will often be necessary to continue to make 360° sweeps with the torque input device otherwise the multiplier will 'unwind'. However, obstructions will often make this impossible (as demonstrated in this example).



AWUR set to counter-clockwise operation



AWUR set to neutral



AWUR set to clockwise operation



HANDTORQUE® HT3-1000



- 5:1 nominal torque multiplication reaction dependant. Ratio with cranked foot is 4.8:1; with straight reaction being 4.9:1
- ±4% torque multiplication accuracy
- Small and compact design
- Updated aesthetics with tough silver metallic powder coat
- Supplied with 2 reaction bar styles for maximum versatility
- Quick-change cranked reaction with improved flexibility allowing reaction in 8 orientations
- Robust construction means minimal maintenance and long life
- If calibration is required, a UKAS accredited calibration certificate may be ordered (at extra cost)

2	HT3-1000
180260	HT3-1000, 1,000 N·m Kit, ½" input x ¾" output

HANDTORQUE® HT3 SERIES

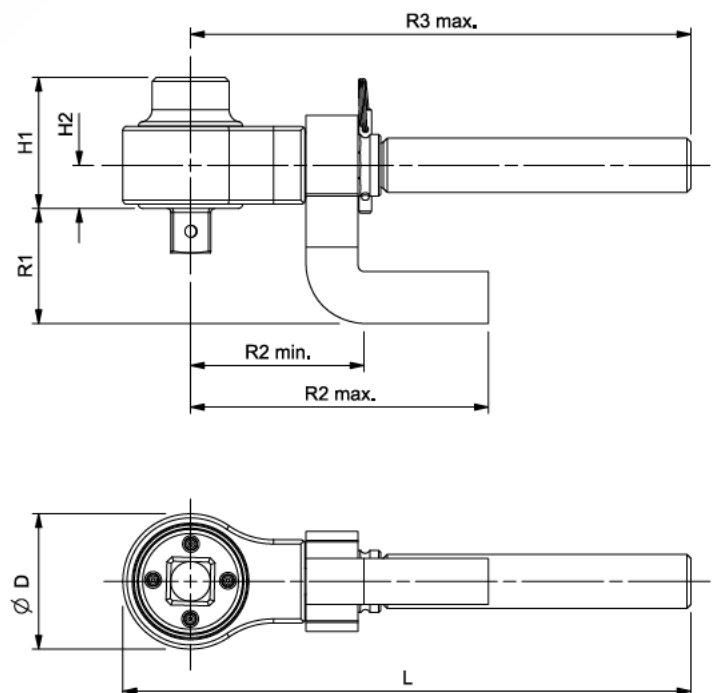


- 5:1 torque multiplication, accuracy ±4%
- Supplied with two reaction bar styles for maximum versatility
- Robust construction means minimal maintenance and long life
- Supplied in a carry case, the Highwayman is ideal for inclusion in the heavy vehicle tool kit
- 1,300 N·m version has a spare ¾" output square included in the kit
- Multiplier head only (no reaction bars or plastic box) also available
- 1,300 N·m version, part no. 17218
- 2,700 N·m version, part no. 17219
- If calibration is required, a UKAS accredited calibration certificate may be ordered (at extra cost)

2	HT3 SERIES
17220	HT3 1,300 N·m Kit, ½" input x ¾" output
17221	HT3 2,700 N·m Kit, ¾" input x 1" output

Kits are supplied in a carry case with a reaction bar and a reaction foot (17220 also contains a spare ¾" sq. dr.)

Model	HT3-1000	HT3 1,300 N m	HT3 2,700 N m
Part Number	180260	17220	17221
Multiplication Ratio	Nominal	5:1	5:1
	With Cranked Reaction	4.8:1	N/A
	With Straight Reaction	4.9:1	N/A
Dimensions (mm)	ØD	65	108
	H1	63	103
	H2	21	44
	L	273	398
	R1	55	77
	R2 min.	83	140
	R2 max.	143	212
	R3 max.	240	344
Tool Weight (kg)	2.7	3.8	3.8
Reaction Weight (kg)	Cranked	0.5	1.36
	Straight	0.7	1.1





HANDTORQUE® HT4 SERIES



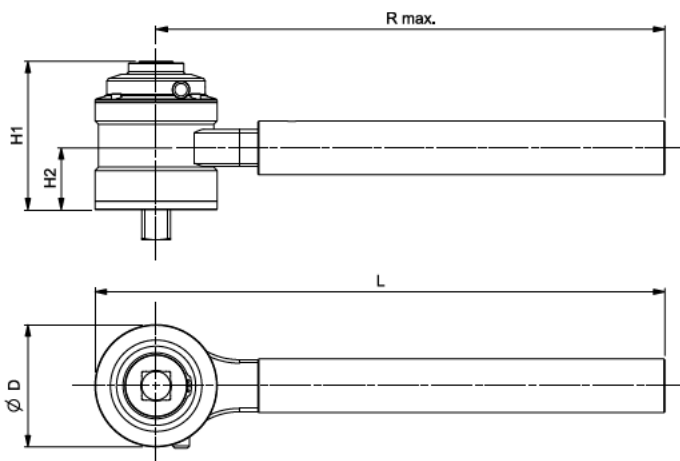
- Robust construction means minimal maintenance and long life
- Mean 15.5:1 (3,000 N·m) or 26:1 (4,500 N·m) torque multiplication, accuracy $\pm 4\%$
- High ratios allow the use of a small torque wrench
- Supplied in carrying case with replacement square drive
- Anti Wind-Up Ratchet fitted to allow safer and more practical operation
- Angle protractor for easy torque and angle tightening
- If calibration is required, a UKAS accredited calibration certificate may be ordered (at extra cost)



4	HT4 SERIES
17022	HT4 3,000 N·m ½" in 1" out AWUR
17021	HT4 4,500 N·m ½" in 1" out AWUR



Model	HT4/15.5 AWUR	HT4/26 AWUR
Part Number	17022	17021
Multiplication Ratio	15.5:1	26:1
Dimensions (mm)	ØD	108
	H1	131
	H2	55
	L	504
	R max.	450
Tool Weight (kg)	6.1	7.0
Reaction Weight (kg)	1.9	1.9



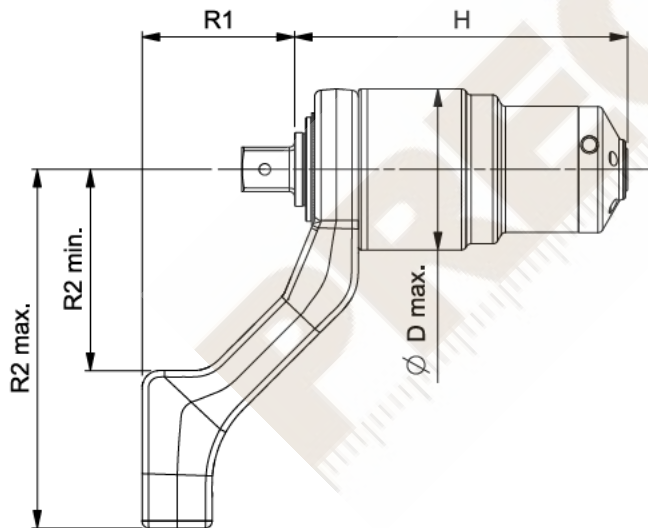


HANDTORQUE® COMPACT SERIES



Sockets not included

- Compact dimensions allow excellent access to applications and easy, safe handling
- Lightweight for torque capacity
- Supplied as standard with an aluminium reaction arm (steel reactions for HT-52). Other options are available on request, including customised reactions
- Torque multiplication accuracy $\pm 4\%$
- Robust, 48 tooth Anti Wind-Up Ratchet (AWUR) contains the forces generated during tightening for safe and easy operation
- Each multiplier is supplied with its own unique calibration certificate allowing the accurate calculation of input torque for critical applications



4 COMPACT SERIES

180200	HT-52/4.7, 1,000 N·m, ½" in ¾" out
180201	HT-52/22.2, 1,000 N·m, ¾" in ¾" out
180202	HT-52/22.2, 1,000 N·m, ½" in ¾" out
180203	HT-52/22.2, 1,000 N·m, ¾" in ¾" out AWUR
180204	HT-52/22.2, 1,000 N·m, ½" in ¾" out AWUR
180205	HT-52/22.2, 1,000 N·m, ¾" in 1" out AWUR
180206	HT-52/22.2, 1,000 N·m, ½" in 1" out AWUR
180208	HT-72/5.2, 1,500 N·m, ½" in 1" out
180209	HT-72/5.2, 1,000 N·m, ¾" in ¾" out
180210	HT-72/5.2, 2,000 N·m, ¾" in 1" out
180212	HT-72/27, 2,000 N·m, ½" in 1" out
180214	HT-72/27, 2,000 N·m, ½" in 1" out AWUR
180215	HT-92/25, 4,000 N·m, ½" in 1" out AWUR
180216	HT-119/25.5, 7,000 N·m, ½" in 1½" out AWUR



11 NOSE EXTENSIONS FOR 72 SERIES

18349.006	6" long, SPM/SPF
18349.009	9" long, SPM/SPF
18349.012	12" long, SPM/SPF
18349.015	15" long, SPM/SPF
18349.018	18" long, SPM/SPF
18330.50	Telescopic Nose Assembly

Note: Square drive fitted from existing tool SPM = Spline Male SPF = Spline Female

Model	HT-52/4.7	HT-52/22.2	HT52/22.2 AWUR	HT-72/5.2	HT-72/5.2	HT-72/27	HT-72/27 AWUR	HT-92/25 AWUR	HT-119/25.5 AWUR
Part Number	180200	180201 180202	180203 180204 180205 180206	180208 180209	180210	180212	180214	180215	180216
Multiplication Ratio	4.7:1	22.2:1	22.2:1	5.2:1	5.2:1	27:1	27:1	25:1	25.5:1
Dimensions (mm)	ØD max.	52	52	72	72	72	72	92	119
	H	91	116	130	140	135	137	154	212
	R1	58	58	58	67	72	72	87	117
	R2 min.	71	71	71	91	91	91	91	115
	R2 max.	131	131	131	166	166	166	166	205
Tool Weight (kg)	1.0	1.3	1.4	2.7	2.7	2.7	3.2	5.4	9.3
Reaction Weight (kg)	0.9	0.9	0.9	0.7	0.7	0.7	0.7	1.4	2.1



HANDTORQUE® COMPACT SERIES KITS



SpinNor included
Part No. 19253

Multiplier & Torque Wrench Kits

For convenience, it is now possible to purchase a torque multiplier from the 'Compact Series' packaged with the appropriate torque wrench, up to 4,000 N·m. This allows the operator to arrive at the bolting application with everything needed in one robust carry case. Space has also been allowed in the carry case for accessories such as sockets.

The torque multiplier is supplied with its own unique calibration certificate and the torque wrench is supplied with a Declaration of Conformance, allowing accurate calculation of input torque to the multiplier for critical applications.

- All kits include a 'SpinNor' which aids fast reaction location
- All models include an Anti Wind-up Ratchet on the multiplier

4	HT COMPACT SERIES & TORQUE WRENCH KITS
18186	HT-52, 1,000 N·m, 3/4" out + NorTorque 60 1/2" Dual Scale
18192	HT-72, 2,000 N·m, 1" out + NorTorque 100 1/2" Dual Scale
18195	HT-92, 4,000 N·m, 1" out + NorTorque 200 1/2" Dual Scale
19253	1/2" SpinNor

HANDTORQUE® STANDARD SERIES



- Mean torque multiplication accuracy ±4%
- High ratios allow the use of a small torque wrench, multipliers can be used where access is limited
- Anti Wind-Up Ratchet available on high ratio models
- Other reaction styles can be designed to suit specific applications
- Electronic torque transducers can be fitted for precise torque monitoring, see page 95
- Other models available up to 300,000 N·m
- If calibration is required, a UKAS accredited calibration certificate may be ordered (at extra cost) up to 6,000 N·m

4	STANDARD SERIES
16010	HT 1/5, 1,700 N·m, 1/2" in 3/4" out
16012.HD	HT 2/5, 1,700 N·m, 3/4" in 1" out
16034.HD	HT 2/25, 1,700 N·m, 1/2" in 1" out
16089.HD	HT 2/25, 1,700 N·m, 1/2" in 1" out AWUR
16014	HT 5/5, 3,400 N·m, 3/4" in 1" out
16028	HT 5/25, 3,400 N·m, 1/2" in 1" out
16090	HT 5/25, 3,400 N·m, 1/2" in 1" out AWUR
16016	HT 6/5, 3,400 N·m, 3/4" in 1 1/2" out
16024	HT 6/25, 3,400 N·m, 1/2" in 1 1/2" out
16092	HT 6/25, 3,400 N·m, 1/2" in 1 1/2" out AWUR
16093	HT 6/125, 3,400 N·m, 1/2" in 1 1/2" out AWUR
16067	HT 7/5, 6,000 N·m, 3/4" in 1 1/2" out
16018	HT 7/25, 6,000 N·m, 1/2" in 1 1/2" out
16065	HT 7/25, 6,000 N·m, 1/2" in 1 1/2" out AWUR
16068	HT 7/125, 6,000 N·m, 1/2" in 1 1/2" out AWUR
16059	HT 9/25, 9,500 N·m, 3/4" in 1 1/2" out
16070	HT 9/25, 9,500 N·m, 3/4" in 1 1/2" out AWUR
16071	HT 9/125, 9,500 N·m, 1/2" in 1 1/2" out AWUR
16082	HT 11/25, 20,000 N·m, 3/4" in 2 1/2" out
16049	HT 11/125, 20,000 N·m, 1/2" in 2 1/2" out AWUR
18085	HT 12/87.5, 34,000 N·m, 3/4" in 2 1/2" out AWUR
16053	HT 13/125, 47,500 N·m, 3/4" in 2 1/2" out AWUR

Other gear ratios may be available upon request.

If AWUR is not required please enquire for part number.

HT 13/125 fitted with weld prepared reaction ring as standard.

AWUR = Anti Wind-Up Ratchet. See page 43

NOTE: Model name does not reflect multiplication ratios, see mean multiplication ratios on page 48

For spares kits for Norbar multipliers, please see page 128.

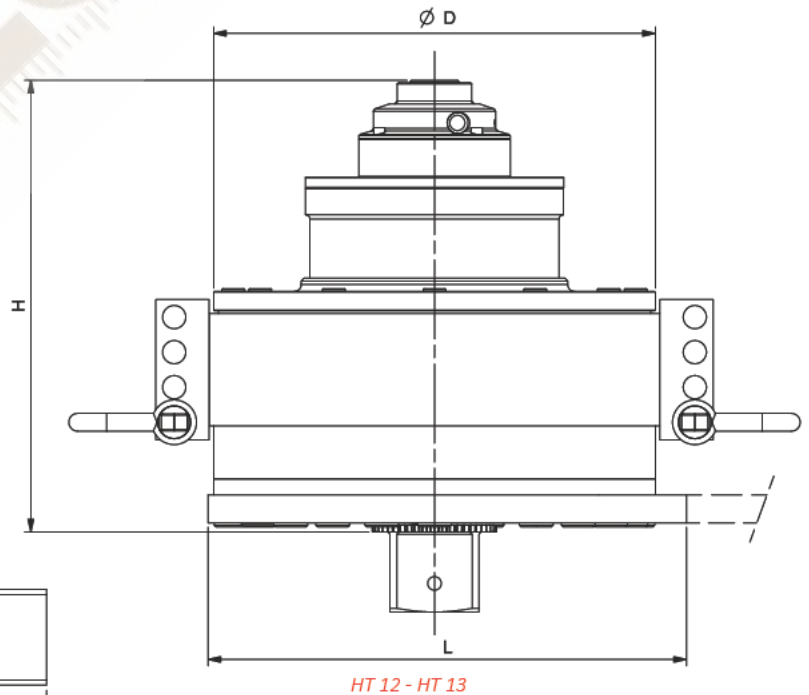
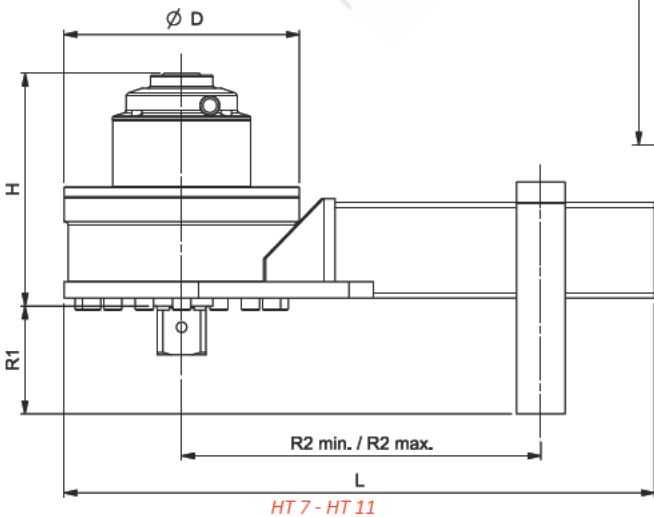
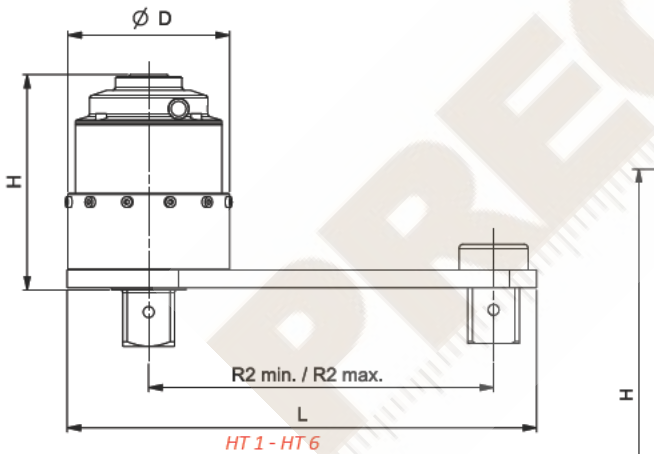


HANDTORQUE® STANDARD SERIES



Model	HT 1/5	HT 2/5	HT 2/25	HT 2/25 AWUR	HT 5/5	HT 5/25	HT 5/25 AWUR	HT 6/5	HT 6/25	HT 6/25 AWUR	HT 6/125 AWUR
Part Number	16010	16012.HD	16034.HD	16089.HD	16014	16028	16090	16016	16024	16092	16093
Mean Multiplication Ratio	5.2:1	5.2:1	27:1	27:1	5.2:1	27:1	27:1	5.2:1	27:1	27:1	135:1
Dimensions (mm)	∅D	108	108	108	108	119	119	119	119	119	119
	H	83	98	98	114	106	127	132	106	128	134
	L	303	303	303	303	355	355	355	355	355	355
	R1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	R2 min.	83	83	83	83	86	86	86	86	86	86
	R2 max.	216	216	216	216	263	263	263	263	263	263
Tool Weight (kg)	3.0	3.2	4.6	6.7	4.7	6.4	7.5	4.7	6.4	7.5	9.0
Reaction Weight (kg)	2.2	2.2	2.2	2.2	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Model	HT 7/5	HT 7/25	HT 7/25 AWUR	HT 7/125 AWUR	HT 9/25	HT 9/25 AWUR	HT 9/125 AWUR	HT 11/25	HT 11/125 AWUR	HT 12/87.5 AWUR	HT 13/125 AWUR
Part Number	16067	16018	16065	16068	16059	16070	16071	16082	16049	18085	16053
Mean Multiplication Ratio	5.2:1	27:1	27:1	135:1	27:1	27:1	135:1	27:1	135:1	TBC	TBC
Dimensions (mm)	∅D	144	144	144	144	184	184	184	212	212	248
	H	136	157	162	188	166	162	182	208	235	281
	L	423	423	423	423	448	448	448	609	609	325
	R1	84	84	84	84	84	84	84	N/A	N/A	N/A
	R2 min.	150	150	150	150	175	175	175	320	320	N/A
	R2 max.	331	331	331	331	351	351	351	500	500	N/A
Tool Weight (kg)	8.1	9.6	10.7	12.2	16.3	17.4	18.9	31.7	32.1	41.5	95.2
Reaction Weight (kg)	6.3	6.3	6.3	6.3	8.3	8.3	8.3	13.3	13.3	6.5	6.9

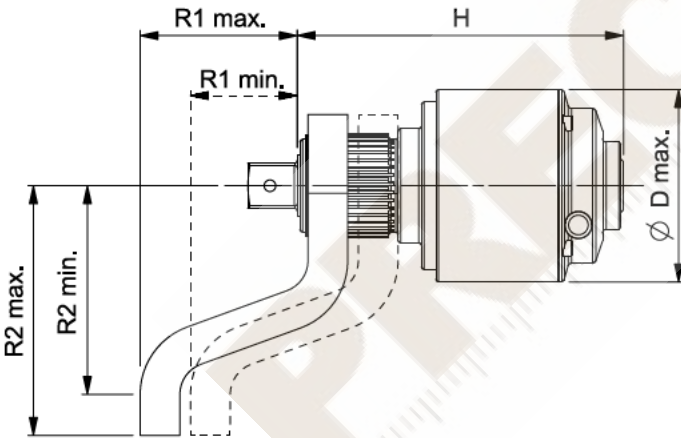




HANDTORQUE® SMALL DIAMETER SERIES



- HandTorque® models HT 30 and 60 have a higher torque output for a given gearbox diameter than the Standard Series
- Reduced diameter enables better access, particularly on pipe flanges
- Reaction taken from high strength spline
- Reaction foot can slide on the spline to allow sockets of various lengths
- Anti Wind-Up Ratchet available on all models (except 5:1 ratios), allowing safer and more practical operation
- If calibration is required, a UKAS accredited calibration certificate may be ordered (at extra cost)



4	SMALL DIAMETER SERIES
18003	HT 30/5, 3,000 N·m, ¾" in 1" out
18004	HT 30/15, 3,000 N·m, ½" in 1" out AWUR
18006	HT 30/25, 3,000 N·m, ½" in 1" out AWUR
18009	HT 60/25, 6,000 N·m, ½" in 1½" out
18008	HT 60/25, 6,000 N·m, ½" in 1½" out AWUR
18013	HT 60/125, 6,000 N·m, ½" in 1½" out

HT 30s and 60s are supplied with a cranked reaction foot. Most small diameter gearboxes are available without AWUR. Please enquire for part numbers.

NOTE: Model name does not reflect multiplication ratios, see mean multiplication ratios below

Model	HT 30/5	HT 30/15 AWUR	HT 30/25 AWUR	HT 60/25	HT 60/25 AWUR	HT 60/125
Part Number	18003	18004	18006	18009	18008	18013
Mean Multiplication Ratio	5.2:1	15:1	27:1	27:1	27:1	135:1
Dimensions (mm)	∅D max.	108	108	108	119	119
	H	164	183	183	212	240
	R1 min.	60	60	60	94	94
	R1 max.	88	88	88	119	119
	R2 min.	117	117	117	146	146
	R2 max.	140	140	140	174	174
Tool Weight (kg)	5.0	7.0	7.0	9.5	10.6	11.0
Reaction Weight (kg)	2.0	2.0	2.0	4.0	4.0	4.0

UKAS ACCREDITED CALIBRATION CERTIFICATION

The part numbers shown below are for 'As Found', for new manual torque multiplying gearboxes up to the maximum capacity shown.

12	ONE DIRECTION
HTCC2.CW	Up to 6,000 N·m / 5,000 lbf·ft
12	TWO DIRECTIONS
HTCC2.CW+CCW	Up to 6,000 N·m / 5,000 lbf·ft

