

## Model TM-391 Torque Multiplier

### WARNINGS

- **Always** maintain firm hand control of torque wrench or input handle while using the multiplier, since recoil (wind-up) will be experienced.
- Inspect output square drive (Fig. 1, Item 3) for visible sign of fatigue or fracture prior to **EACH** use. Replace if necessary (see Section 8).
- Failure of the output square drive, due to torque overload or fatigue, could result in an immediate torque release, potentially causing the torque multiplier to fall from the fastener, and result in personal injury.
- **Do not** hold torque multiplier or reaction anchor tube (Fig. 1, Item 2) while applying torque since normal multiplier deflection might cause fingers to be pinched; especially in confined locations.
- **Do not** use output drive extensions. Increased deflections, caused by the added length could force the socket off the nut, or break the extension or socket.
- Since reaction torque equals **OUTPUT** torque, be sure to select an anchor point sufficient to withstand the torque reaction forces created.

### 1. INTRODUCTION

This handbook covers operation and service instructions for the model TM-391 torque multiplier.

### 2. IMPORTANT INSTRUCTIONS

- 2.1 Read and understand these operating instructions before using the Torque Multiplier.
- 2.2 **DO NOT USE AN IMPACT WRENCH ON THE TORQUE MULTIPLIER. DAMAGE TO TOOL COULD OCCUR.**
- 2.3 When positioning the torque multiplier, be sure socket attached to the output is positioned so that the reaction tube is at a right angle to the fastener. Torque reaction creates a rotational force in the opposite direction from which input force is applied. See [Application Tips](#) for additional torque multiplier reaction information.
- 2.4 **Remember:** Breakout torque can be much greater than the make up torque value. Be sure that the multiplier being used has sufficient capacity for torque breakout. Allow a minimum of 50% additional capacity in the tool for breakaway torque. Damaged and corroded fasteners can require even greater breakaway torque capacity.
- 2.5 When using the torque multiplier without a torque wrench to monitor input torque, remember that the **output torque** is significantly greater than the applied **input torque**. Do not apply more torque than the application can withstand.
- 2.6 Use only Williams approved output square drives and replacement parts.

### 3. DESCRIPTION AND DESIGN FEATURES

- 3.1 The TM-391 torque multiplier uses a planetary geared action to tighten and loosen nuts, bolts and cap screws with a continuous 360° rotation in either clockwise or counterclockwise direction. Input and output rotation directions are the same (EXAMPLE: Clockwise input rotation creates clockwise output rotation).

- 3.2 The reaction anchor tube is held in place by a spring loaded detent pin, which is easily removed by depressing the end of the plunger. **Note:** The torque multiplier's anchor stub can be used as a suitable anchor in confined areas.
- 3.3 A controlled-shear output square drive (Fig. 1 Item 3) protects internal components in the event maximum output capacity is exceeded. This overload-protection feature causes the drive to fracture when output exceeds from 3% to 10% of rated output capacity. One replacement drive is included with the torque multiplier. Additional replacements can be ordered from Williams.
- 3.4 An optional pneumatic power drive is available to convert the torque multiplier from manual to pneumatic operation.

### 4. SPECIFICATIONS

Output Capacity Lbf-ft (N·m)	1,200 (1,627)
Input Capacity Lbf-ft (N·m)	200 (271)
Gear Ratio	6.33:1
Torque Ratio	6:1
Accuracy	±5% of reading from 20% to 100% of full-scale rating
Output Drive Male Square Size Inch (mm)	.75 (19)
Input Drive Female Square Size Inch (mm)	.5 (13)
Overall Dimensions Inch (mm)	Gearbox Ø: 3.94 (100) Height: 4.00 (102) Length: 19.56 (497)
Net Weight Lb. (kg)	9.1 (4.1)
Planetary Gearing Stages	One
Needle Bearings	Yes
Angle-of-turn Protractor	Yes (5° increments)
Torque Conversion Chart	Yes
Shearable Replaceable Output Drive	Yes
Reaction Anchor Type	Tubular

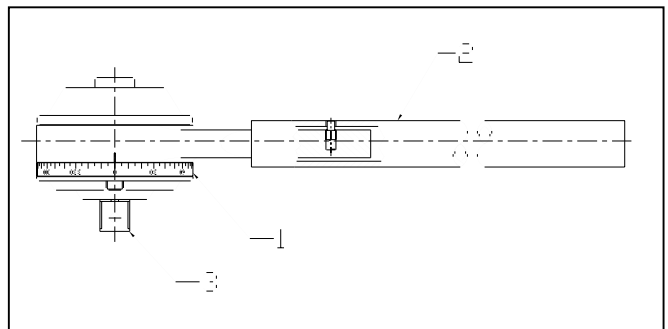


Figure 1.

1. Angle of Turn Protractor
2. Reaction Handle (secured in position over anchor stub)
3. Controlled-Shear Output Square Drive Assembly

## 5. TORQUE CONVERSIONS

- 5.1 A data plate is attached to the torque multiplier which displays the input torque required to obtain the listed output torque values. If you wish to calculate a specific input value that isn't listed on the attached chart, divide the desired output torque by the multiplier's torque ratio (6) to determine the input torque required (e.g. 900 Lbf-ft output torque / 6 torque ratio = 150 Lbf-ft input torque).

## 6. MANUAL OPERATION

- 6.1 Mount the proper size square female drive socket onto the torque multiplier's output square drive (Fig. 1 Item 3), then position socket and torque multiplier on the fastener to be tightened.
- 6.2 Butt the reaction anchor tube securely against a suitable object. **Remember:** When socket is properly positioned on fastener, reaction anchor tube must be at a right angle to the fastener to which torque is being applied. See [Application Tips](#) for additional torque reaction information.
- 6.3 To tighten manually with torque wrench: Determine the input torque required to obtain the desired output by referring to the torque data plate attached to the torque multiplier's reaction anchor tube. Output torque accuracy requires the use of an accurate torque wrench in series with the torque multiplier.
- 6.4 Failure of the output square drive, due to torque overload or fatigue, could result in an immediate torque release, potentially causing the torque multiplier to fall from the fastener, and result in personal injury. (See **▲ Warnings**)
- 6.5 Apply torque with torque wrench until desired input torque is achieved. Slowly and carefully relax input torque and remove multiplier from application.
- 6.6 To Loosen: Apply torque in the counter-clockwise direction until fastener is loose.

## 7. PNEUMATIC OPERATION

- 7.1 If you decide to use a **non-impact** power drive to speed up the process of tightening or loosening fasteners, make certain that the power drive is set to deliver no more than the maximum allowable input torque. A lightweight, reversible air motor is available for use with this line of multipliers. When equipped with the optional air pressure regulator, torque output can be controlled.

## 8. REPLACING A SQUARE DRIVE ASSEMBLY

- 8.1 Remove the broken Square Drive by insert a prying tool under the retaining ring (See Figure 2) and pulling out the old drive component.
- 8.2 Insert the new Square Drive Assembly.
- 8.3 Re-insert the retaining ring into the groove on the output gear cage.



Figure 2. Square Drive Removal

## Torque Multiplier Application Tips

### 1. INTRODUCTION

This handbook covers general torque multiplier usage. Some of the illustrations and information may not apply to your specific torque multiplier or application.

### 2. TORQUE MULTIPLIER REACTION

- 2.1 There are many different ways of absorbing torque multiplier reaction forces. Although the methods are as varied as the applications, there are common practices that should be taken into consideration.
- 2.2 The first item to consider is the size and type of torque tool required for the application. Survey space limitations as well as the maximum torque needed. Be sure to allow a minimum of 50% additional capacity in the tool for breakaway torque. Damaged and corroded fasteners can require even greater breakaway torque capacity. Allow a minimum of 100% over the make-up torque for these conditions. **Example:** A heat exchanger with corroded studs and a 1,500 Ft-Lbs. make-up torque. Choose a tool with a capacity of at least 3,000 Ft-Lbs. for breakaway.
- 2.3 Be sure that the anchor point is solid and has minimum deflection.
- 2.4 Determine where the reaction anchor forces are going to take place (e.g. against a flange or over an adjacent bolt). Make sure that this point can withstand the torque tool's reaction forces. For example consider a 3,200 Ft-Lb. torque multiplier, with reaction near the end of its anchor stub (figure 1). This will produce a reaction force of about 6,400 pounds. By moving the reaction to the end of the anchor tube, the force is reduced to about 2,400 pounds. Keeping the reaction point tangent to the rotation of the torque output is necessary to prevent the resultant forces from increasing even more (figures 2 and 3).
- 2.5 Keep output torque rotation as pure as possible by reducing bending moments. Bending moments decrease torque efficiency, reduce the torque applied to the application and are hard on the tool and sockets. This can be done by taking torque reaction as far out on the reaction anchor as possible. Also keep the distance between the tool's output and the fastener as short as possible (figure 2).
- 2.6 Keeping these factors in mind when devising a torque reaction system will help increase tool life and create a much safer working environment.

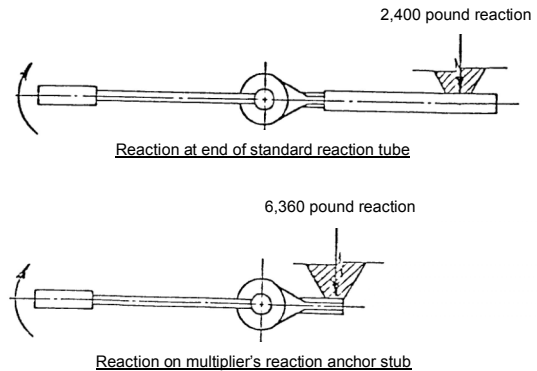
### 3. POWERED APPLICATION

- 3.1 When using air, electric or hydraulic tools to power torque multipliers, many variables must be considered before accurate results can be expected.

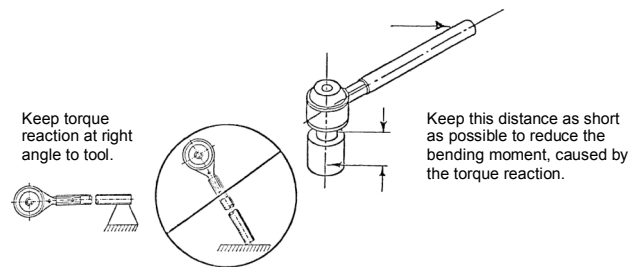
**CAUTION:** Impact type air tools should never be used with torque multipliers. Torque multiplier damage could occur.

- 3.2 Air tools operate best when clean, dry, well-lubricated air is used. The use of an air filter, lubricator and regulator are a must for reliable operation. It is also important to maintain enough airflow from the

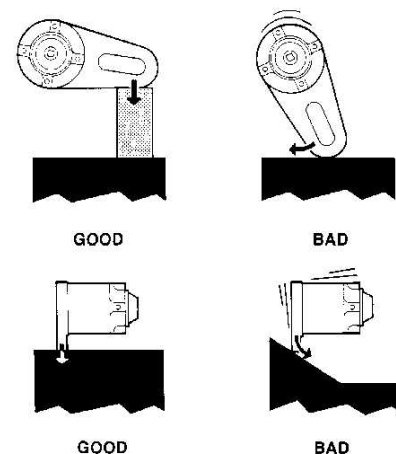
compressor's receiver. If the airflow (CFM) rating drops below that expected by the air tool, lower than



**Figure 1**  
Reaction forces increase the closer the reaction point is to the multiplier.



**Figure 2**  
Minimize bending moments created by the torque multiplier's reaction.



**Figure 3**  
Keep reaction anchor perpendicular to the reaction point.

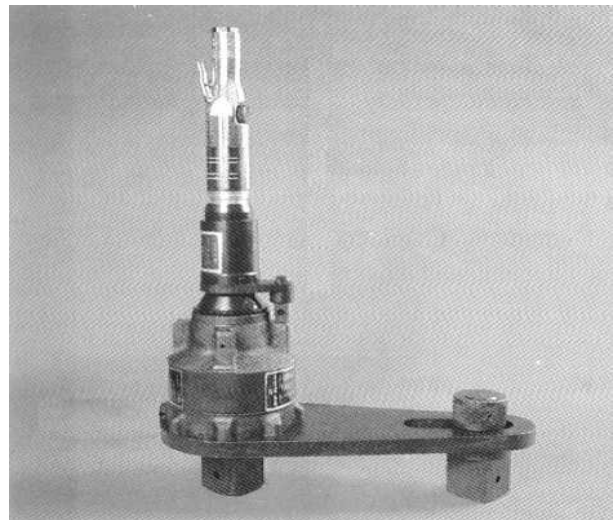
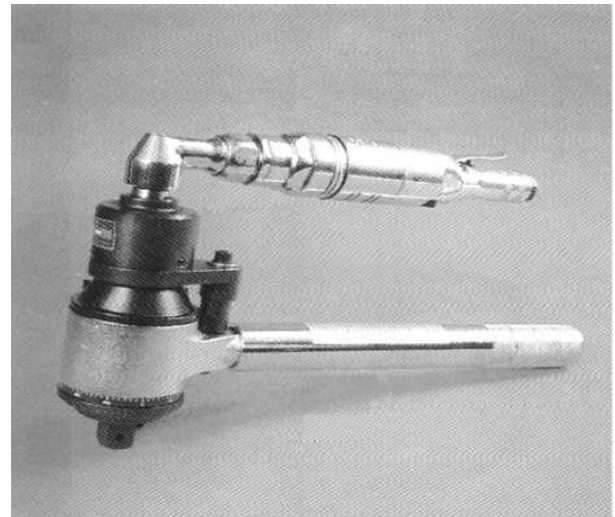
anticipated torque output may result.

- 3.3 The simplest way to control the torque output is by regulation of the air pressure supplied to the air motor. The more accurate the air pressure control, the more reliable the torque control.
- 3.4 Attach an air pressure regulator as close to the air tool as possible. This will reduce pressure variations due to changes in air hose length & diameter or changes in quick disconnects and pipe fittings.
- 3.5 Dirty or corroded fastener threads can cause large fluctuations in the applied torque. It is recommended that a high quality lubricant be applied to the fastener threads as well as all other surfaces that rub. This will reduce losses in torque efficiency.
- 3.6 Changes in momentum of the air tool are the greatest cause of output torque variations. The higher the tools speed the greater the effects of momentum.
- 3.7 A soft stack-up has a large amount of application run-down time due to long studs, flat/lock washers, gaskets, etc. This will cause the air tool to run a longer time before reaching the desired torque. This decreases air motor momentum and decreased the applied torque. Conversely, a hard stack-up has a short run-down time due to short studs, very rigid application, etc. This will reach the desired torque very quickly, applying a greater torque to the fastener.
- 3.8 Angle nutsetters and inline air tools each have distinct advantages and disadvantages.
- 3.9 An inline air tool has the advantage of being fastened to the torque multiplier rigidly by bolting. This allows the operator to handle a single piece of equipment and the input torque reaction is absorbed by the bolted connection. The chief disadvantage is the tools height.
- 3.10 An angle nutsetter has the advantage of a lower tool profile but requires the tool operator to react the angle nutsetter's torque output. This reaction torque can be quite large (up to 200 Lb-Ft of torque) The reaction torque and the size of the air tool required can be reduced to under 40 Lbf-Ft by the use of an optional accessory gear box attached to the input of the torque multiplier. Although this does increase the tool height slightly, it is still lower in height than an inline tool.
- 3.11 If the angle nutsetter and torque multiplier are sized for the make-up torque required, a medium output (85 - 110 Ft-Lb.) angle nutsetter can be used. This combination will maximize the air tool speed while reserving some torque multiplier capacity for higher breakout torques. If necessary the fasteners can be broken loose manually, then run off can be completed using the air tool.

#### 4. ANGLE OF TURN PROTRACTOR

- 4.1 Some torque multipliers include an Angle of Turn Protractor, which allows the operator to accurately measure a specific number of degrees of rotation of the fastener. The torque / angle of turn method of tightening fasteners requires a pre-torque value, and a specific additional rotation of the fastener, that is engineered into the application. This data will be supplied by the

original equipment manufacturer's engineering department if angle of turn torquing is applicable.



**Figure 4**  
Torque multiplier's with air motors attached for powered application.



This tool conforms with the requirements for CE Marking.

ITEM NO.	PART NO.	DESCRIPTION	QTY
1	391-15	ASSEMBLY, PLANET GEAR WITH BEARING	4
2	391-18	ANCHOR, REACTION	1
3	391-2	PINION, INPUT	1
4	391-202	PLATE, NAME / DATA	1
5	391-31	CARRIER, SQUARE DRIVE	1
6	391-421	ASSEMBLY, INPUT END (WITH DOWEL PINS)	1
7	391-62	ASSEMBLY, RING GEAR	1
8	TM-391RSD	SQUARE DRIVE REPLACEMENT KIT	1
9	392-55	PROTRACTOR	1
10	904057	BEARING	1
11	935158	PIN, CLEVIS	1
12	A000151804001	SCREW, SOCKET HEAD CAP	4

**Gears are only available with bearings installed as an assembly**

