TO 32B14-3-1-101

TECHNICAL MANUAL

OPERATION AND SERVICE INSTRUCTIONS

TORQUE INDICATING DEVICES

This manual supersedes TO 32B14-3-1-101 dated 2 June 2018.

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INTRODUCTION

1 PURPOSE.

The purpose of this technical order is to provide operation and service instructions for standard Air Force torque devices used to obtain predetermined torque values on low, medium and high pressure hoses, tubing, nuts, bolts and related fasteners. These instructions are also applicable to torque values on all types of fasteners wherever torque control is required. This technical order is applicable to all applicable federal stock classes.

2 SCOPE.

This manual consists of the following:

Chapter 1	Description
Chapter 2	Definitions
Chapter 3	Torque Problem
Chapter 4	Torque Conversions
Chapter 5	Torque Values, AN and MS Nuts
Chapter 6	Operation
Chapter 7	Maintenance and Adjustment

NOTE

The term ‘‘devices’’ is used in this technical order to denote ‘‘handle’’, ‘‘wrench’’, ‘‘screwdriver’’, etc., as applicable.

3 GSA DISCREPANCY REPORT CENTER.

1-800-488-3111 for discrepancies concerning GSA and ‘‘SCIT’’ acquired torque devices.

4 ABBREVIATIONS.

All abbreviations used in this manual are shown in the list of abbreviations below. Standard abbreviations are in accordance with ASME Y14.38, Abbreviations and Acronyms for Use on Drawings and Related Documents.

AF	Air Force
AFMETCAL	Air Force Metrology and Calibration Program
AFTO	Air Force Technical Order
ASSY	Assembly
AV	Avoirdupois
CDI	Consolidated Devices Inc.
CW	Clockwise
CCW	Counterclockwise
DLA	Defense Logistics Agency
DoD	Department of Defense
ESDS	Electrostatic Discharge Sensitive
FOD	Foreign Object Damage
HCI	Hardness Critical Items
IMI	Interactive Multimedia Instruction
JVISDA	United States Army Visual Information Center
NSN	National Stock Number
PMEL	Precision Measurement Equipment Laboratory

PN	Part Number
PSI	Pounds per Square Inch
TCTO	Time Compliance Technical Order
TMDE	Test Measurement and Diagnostic Equipment
TO	Technical Order
TOMA	Technical Order Management Agency
USAF	United States Air Force
WRM	War Reserve Material

5 RELATED PUBLICATIONS.

NOTE

When searching technical order (TO) numbers in the Enhanced Technical Information Management System (ETIMS) catalog, please use the wildcard (*) after typing in the TO number. Many TOs are not available in paper format, (i.e., digital (WA-1) or Compact Disk (CD-1)). This ensures TOs in all media formats will populate the search.

The following publications contain information in support of this technical manual.

List of Related Publications

Number	Title
ASME Y14.38	Abbreviations and Acronyms for Use on Drawings and Related Documents
DODI 5330.03_AFI 33-395	Defense Logistics Agency (DLA) Document Services
TO 00-5-1	AF Technical Order System
TO 00-20-14	Air Force Metrology and Calibration Program
TO 00-25-195	AF Technical Order System Source, Maintenance, and Recoverability Coding of Air Force Weapons, Systems, and Equipments
TO 00-25-234	General Shop Practice Requirements for the Repair, Maintenance, and Test of Electrical Equipment
TO 1-1A-8	Engineering Manual Series, Aircraft and Missile Repair, Structural Hardware
TO 32B14-3-1-101	Operation and Service Instructions Torque Indicating Devices
TO 33K-1-100-1	Calibration Procedure for Maintenance Data Collection Code and Calibration Measurement Summaries
TO 33K6-4-2193-1	Calibration Procedure for Snap Action, Impulse Feel Torque Wrenches
TO 33K6-4-3014-1	Calibration Procedure for Torque Screwdrivers and Limiters (General)
TO 33K6-4-3015-1	Calibration Procedure for Torque Watches, Deflecting Beam and Rigid Case Dial Indicating Torque Wrenches
TO 33K6-4-3016-1	Calibration Procedure for Torque Multipliers Using CDI Torque Calibration Systems
TO 33K6-4-3017-1	Calibration Procedure for Torque Handles

6 RECORD OF APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS (TCTOS).

List of Time Compliance Technical Orders

TCTO Number	TCTO Title	TCTO Date
None		

7 HCI HARDNESS CRITICAL ITEMS (HCI).

CAUTION

The HCI symbol (HCI) establishes special requirements limiting changes and substitutions and that the specific parts listed must be used to ensure hardness is not degraded.

If included, items with nuclear survivability requirements are marked with the HCI symbol (HCI). All changes to, or proposed substitutions of, HCIs must be approved by the acquiring activity.

8 ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) ITEMS.

CAUTION

All ESDS parts shall be handled in accordance with the ESDS device handling procedures in TO 00-25-234.

If included, items containing ESDS parts are marked with the ESDS symbol ( ).

9 CHANGE RECOMMENDATIONS.

Recommendations proposing changes to this TO shall be submitted through ETIMS. Refer to TO 00-5-1.

SAFETY SUMMARY

1 GENERAL SAFETY INSTRUCTIONS.

This manual describes physical and/or chemical processes which may cause injury or death to personnel, or damage to equipment, if not properly followed. This safety summary includes general safety precautions and instructions that must be understood and applied during operation and maintenance to ensure personnel safety and protection of equipment. Prior to performing any specific task, the WARNINGs, CAUTIONs, and NOTEs included in that task shall be reviewed and understood.

2 WARNINGS, CAUTIONS, AND NOTES.

WARNINGs and CAUTIONs are used in this manual to highlight operating or maintenance procedures, practices, conditions, or statements which are considered essential to protection of personnel (WARNING) or equipment (CAUTION). WARNINGs and CAUTIONs immediately precede the step or procedure to which they apply. WARNINGs and CAUTIONs consist of four parts: heading (WARNING, CAUTION, or icon), a statement of the hazard, minimum precautions, and possible results if disregarded. NOTEs are used in this manual to highlight operating or maintenance procedures, practices, conditions, or statements which are not essential to protection of personnel or equipment. NOTEs may precede or follow the step or procedure, depending upon the information to be highlighted. The headings used and their definitions are as follows:

WARNING

Highlights an essential operating or maintenance procedure, practice, condition, statement, etc. Failure to comply could result in injury to, or death of, personnel or long term health hazards.

CAUTION

Highlights an essential operating or maintenance procedure, practice, condition, statement, etc. Failure to comply could result in damage to, or destruction of, equipment or loss of mission effectiveness.

NOTE

Highlights an essential operating or maintenance procedure, condition, or statement.

CHAPTER 1
DESCRIPTION

1.1 APPROVED TORQUE DEVICES.

The torque devices described herein are those which have been tested and satisfactorily passed the qualification requirements set forth in latest revisions and amendments of Specifications GGG-W-686 (impulse feel, manually operated torque wrenches), CID A-A-1274 (for deflection beam torque wrenches), CID A-A-2411 (for rigid case dial indicating wrenches), CID A-A-2414 (for screwdriver type wrenches), and GGG-N-1907 powered nutrunners and screwdrivers). Standard stock listed and other torque wrenches are not stock listed, but are produced by professional tool manufacturers that conform to referenced specification are deemed satisfactory for general application, quality and capacity to fulfill United States Air Force (USAF) torquing requirements. Shop designed and manufactured torque wrenches are not approved for use where close torquing accuracy is required. Under no circumstances shall a torque device that does not meet the minimum requirements of the above referenced specifications be used within the Air Force System unless it is a special torque device authorized for a specific application.

1.2 APPROVED TORQUE HANDLES AND GGG-W-686 (IMPULSE FEEL, MANUALLY OPERATED WRENCHES).

Sweeney Torque Wrench, Part Number (PN) SWE51, National Stock Number (NSN) 5120-00-819-1049, is authorized for use with B.K. Sweeney Power wrench, Model SWE8100, NSN 5120-00-337-9652. Typical examples for approved torque tools are not illustrated in this technical order. Illustrations contained in specifications referred to in Paragraph 1.1 should suffice. Typical torque devices are demonstrated in training films referenced in Paragraph 6.1.

CHAPTER 2
DEFINITIONS

2.1 FORCE.

A force is defined as any cause tending to produce or modify motion. The units by which a force is usually measure are ounces, pounds, grams, or kilograms. Besides force there is one other elementary quantity in mechanics from which numerous compound quantities are derived. This is distance, expressed as inches, feet, meters, or millimeters.

2.2 TORQUE.

Torque in mechanics, is the product of a tangential force (weight) times the perpendicular distance to a center of rotation. This is usually expressed in units of distance and weight (force) as Inch-ounces, Inch-pounds, Foot-pounds, Gram-millimeters, and/or Kilogram-meters. The about explanation is further explained in Figure 3-1.

2.3 CHARACTERISTICS OF FORCE.

Three characteristics which, when known, determine force. They are direction, place of application, and magnitude. The direction of a force is the direction in which it tends to move the body (nut or bolt) upon which it acts. The “place of application” is generally assumed to be a point, as the center of rotation. In reference to Figure 3-1, the resulting torque is the applied force multiplied by its perpendicular distance to the center of the bolt or nut. The magnitude of this torque is expressed as Inch-ounces, Inch-pounds, Foot-pounds, Gram-millimeters, and/or Kilogram-meters.

2.4 CALIBRATION.

A checking operation to determine accuracy or inaccuracy of a torque tool using a suitable torque wrench tester.

2.5 ALIGNMENT.

Actual adjustments necessary to bring a torque tool into acceptable tolerance.

2.6 IN USE.

Torque devices removed from their normal storage location, during a work shift, to perform torquing tasks during the same work shift.

2.7 IN STORAGE.

Torque devices in their normal storage location between work shifts.

2.8 REMOVED FROM SERVICE.

Torque devices in supply stocks, or not being used for an extended period of time, due to lack of need, or in special storage, such as in a War Reserve Material (WRM) or mobility package.

2.9 CLOCKWISE (CW).

In the direction in which the hands of a clock rotate as viewed from the front.

2.10 COUNTERCLOCKWISE (CCW).

In a direction opposite to which the hands of a clock rotate as viewed from the front.

CHAPTER 3
TORQUE PROBLEM

3.1 SIMPLE TORQUE PROBLEM.

Figure 3-1 illustrates a simple torque problem. Assuming that a 2 pound force was applied at a perpendicular (tangential to center of rotation) lever arm distance of 3 feet the torque applied is 2 pounds times 3 feet which equals 6 Foot-pounds.

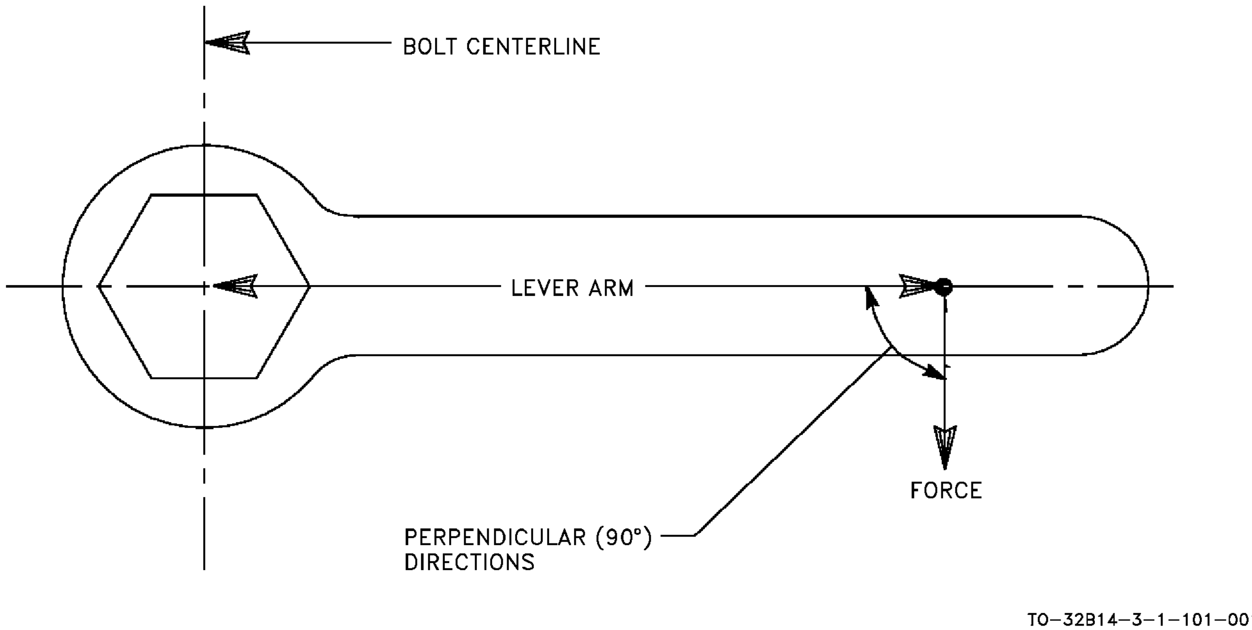

Figure 3-1. Simple Torque Problem

CHAPTER 4
TORQUE CONVERSIONS

4.1 CONVERSION FACTORS.

Occasionally, it is necessary to convert torque values to different units and different systems of linear measurements and weights. Multiplication factors as shown in Table 4-1 are applicable for obtaining these conversions.

Table 4-1. Torque Conversion

Unit	Multiplied By	Equals
Ounce (AV) - Inches	720.09	Gram-millimeters
Gram-millimeters	0.0013887	Ounce (AV)-inches
Inch-pounds (AV)	0.0115214	Kilogram-meters
Kilogram-meters	86.7947	Inch-pounds (AV)
Foot-pounds (AV)	0.138257	Kilogram-meters
Kilogram-meters	7.23289	Foot-pounds (AV)
Inch-pounds (AV)	16	Inch-ounces (AV)
Inch-ounces (AV)	0.0625	Inch-pounds (AV)
Foot-pounds (AV)	12	Inch-pounds (AV)

NOTE

Avoirdupois (AV) is weight; sixteen ounces equals one pound.

CHAPTER 5
TORQUE VALUES, AN AND MS NUTS

5.1 GENERAL.

Torque values for installing AN castellated and self-locking steel nuts or steel bolts are listed in Table 5-1. This Table is based on threads of Class 3 fit, and non-lubricated. Unless otherwise specified, threads of bolts and nuts will be clean, dry, and free from oil or grease when torque tested. The torque values shown are for general purpose installations, stressing bolts to approximately 40,000 Pounds per Square Inch (PSI). For special installations where bolts are to be preloaded, consult technical instructions covering equipment involved. Whenever possible, torque should be applied to nuts. However, when unable to torque a nut, the bolt will be torqued using the higher limit of the torque values of columns 2 and 3 of Table 5-1.

NOTE

Refer to Figure 5-1 for guidance on how to properly and sequentially torque hardware which is installed in rectangular, circular, or straight patterns.When tightening castellated nuts on bolts, it is possible that the cotter pin holes will not line up with the slots in the nuts for the range of recommended installation listed in columns 2 and 3 of Table 5-1. In such a case, the nut may be over tighten just enough to line up the nearest slot with the cotter pin hole, but the maximum applied torque will not exceed the values listed in columns 4 and 5 as applicable. These values are maximum for tightening nuts on AN bolts heat-treated to a minimum of 125,000 PSI in tension, but are not necessarily the maximum tightening torques for higher strength bolts.

5.2 BOLTS LOADED IN SHEAR.

Castellated steel nuts, AN310, and self-locking steel nuts, MS21042 and similar types, when installed on aircraft steel bolts, AN-3 and AN-20 series and equivalent types, will be tightened to within the values listed in column 2, Table 5-1, which stress the threaded section of the bolts to an initial tensile stress of approximately 40,000 PSI. Shear type nut, such as AN320 and MS21083, installed on steel aircraft bolts will be tightened (column 3, Table 5-1) approximately 60 percent of the values on thick nuts.

5.3 BOLT LOADED IN TENSION.

AN310 and MS21042 nuts or similar tension nuts installed on aircraft bolts, AN-3 and AN-20 series and equivalent types, may be tightened to higher torque values than those listed in column 2, Table 5-1, provided yielding of the nut-bolt assembly does not occur while tightening the assembly. Tension type nuts installed on AN-3 and AN-20 series bolts will not be tightened in excess of the values listed in column 4 of Table 5-1. These values give a combined tensile stress in the threaded shank of the bolt of approximately 90,000 PSI, and apply to non-lubricated nuts and bolts. When higher torque values than those listed in columns 2 and 3 are necessary for proper installation, these higher torque values will be listed in the appropriate erection and maintenance manual for aircraft, and the overhaul manuals for engines and accessories. If bolts or nuts under contractor's part numbers are to be torqued, these torque values will be listed in the appropriate erection and maintenance manual for aircraft, and the overhaul manual for engines and accessories.

5.4 DIFFERENCE BETWEEN TABLE 5-1 AND OTHER MAINTENANCE INSTRUCTIONS.

Table 5-1 is for use as a guide in the event of absence of particular values in other maintenance instructions. If there is a difference between values shown in Table 5-1 and values shown in maintenance instructions for particular systems or TO 1-1A-8, the values shown in these maintenance instructions and/or TO 1-1A-8 should take precedence over the values shown in Table 5-1.

Table 5-1. Torque Values

1	2	3	4	5
Size	Torque Limits Recommended for Installation (Inch-pounds) (Bolts Loaded Primarily in Shear)		Maximum allowable Tightening Torque (Inch-pounds)	

Table 5-1. Torque Values - Continued

1	2	3	4	5
Nut Bolt	Tension Type Nuts MS21042 and AN310 (40,000 PSI in bolt)	Shear type Nuts MS1083 and AN320 (approximately 60 percent of column 2)	MS21042 and AN310 Nuts (90,000 PSI in bolts)	MS21083 and AN320 Nuts (approximately 60 percent of column 4)
FINE THREAD SERIES				
8-36	12-15	7-9	20	12
10-32	20-25	12-15	40	25
1/4-28	50-70	30-40	100	60
5/16-24	100-140	60-85	225	140
3/8-24	160-190	95-110	390	240
7/16-20	450-500	270-300	840	500
1/2-20	480-690	290-410	1,100	660
9/16-18	800-1,000	480-600	1,600	960
5/8-18	1,100-1,300	660-780	2,400	1,400
3/4-16	2,300-2,500	1,300-1,500	5,000	3,000
7/8-14	2,500-3,000	1,500-1,800	7,000	4,200
1-14	3,700-5,500	2,200-3,300	10,000	6,000
1-1/8-12	5,000-7,000	3,000-4,200	15,000	9,000
1-1/4-12	9,000-11,000	5,400-6,600	25,000	15,000
COARSE THREAD SERIES				
8-32	12-15	7-9	20	12
10-24	20-25	12-15	35	21
1/4-20	40-50	25-30	75	45
5/16-18	80-90	48-55	160	100
3/8-16	160-185	95-110	215	170
7/16-14	235-255	140-155	475	280
1/2-13	400-480	240-290	880	520
9/16-12	500-700	300-420	1,100	650
5/8-11	700-900	420-540	1,500	900
3/4-10	1,150-1,600	700-950	2,500	1,500
7/8-8	2,200-3,000	1,300-1,800	4,600	2,700
1-8	3,700-5,000	2,200-3,000	7,600	4,500
1-1/8-8	5,500-6,500	3,300-4,000	12,000	7,200
1-1/4-8	6,500-8,000	4,000-5,000	16,000	10,000

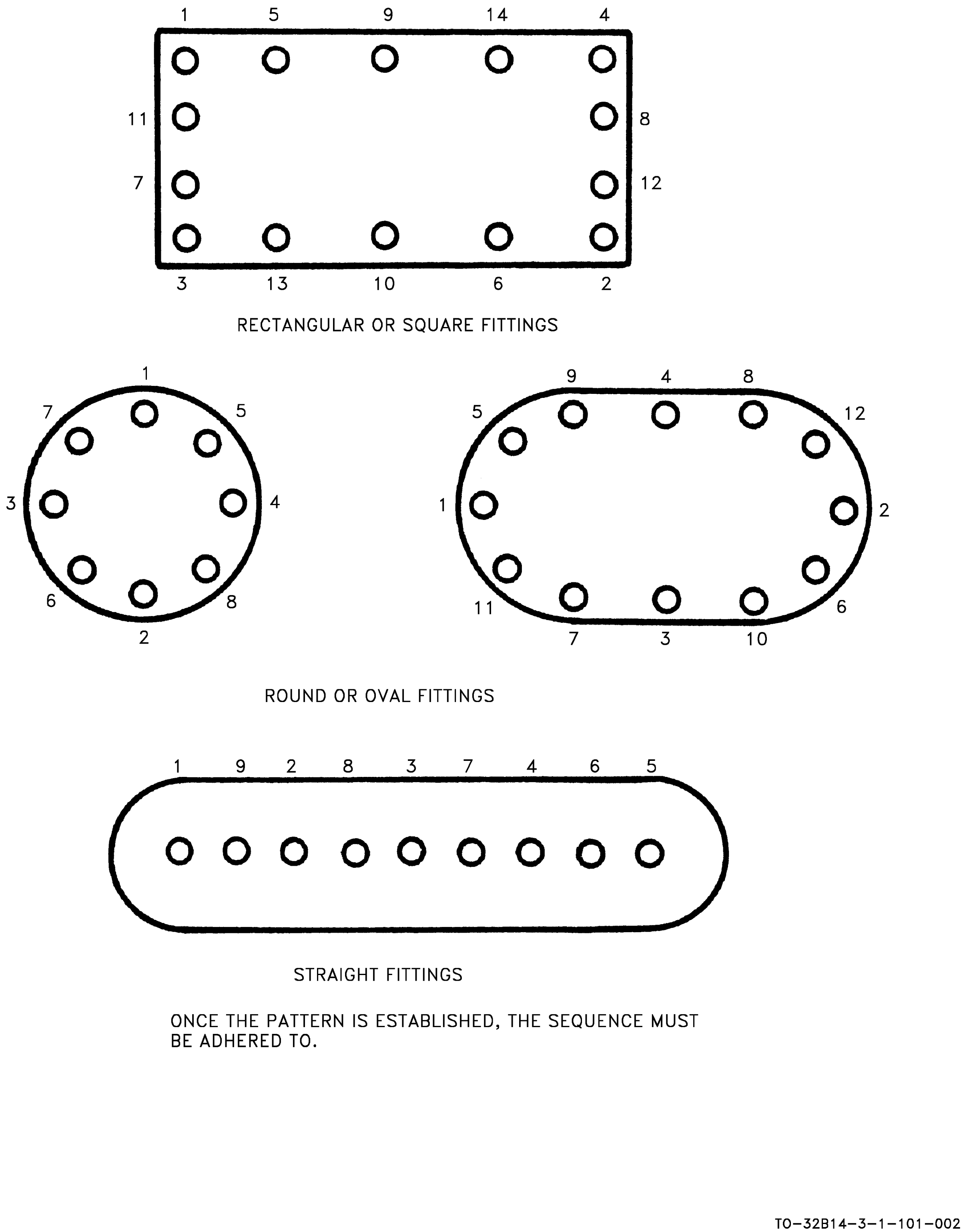

Figure 5-1. Torque Values

CHAPTER 6
OPERATION

6.1 GENERAL.

The use of a torque device is not considered to be complicated. However, to properly use a torque device the mechanic must possess and demonstrate a basic knowledge of torquing technique. The importance of torque control must not be underestimated; neither should approved torquing practices be deviated from, nor disregarded. To acquaint concerned personnel with approved torquing practices, torque familiarization audiovisual (AV) productions or interactive multimedia instruction (IMI) products are available upon request for all field and depot level maintenance activities for the United States Army Visual Information Center (JVISDA), SAM-OPV-J-AS, Building 3/ Bay 3, 11 Hap Arnold Blvd., Tobyhanna, PA 18466–5102 or http://www.redstone.army.mil/davis/. Requirements for these AV and IMI productions must be submitted in accordance with AFI 33-117, Jun 94. Referenced AV and IMI productions are:

- AV = PRECISION MEASURING TOOLS, M1A1 TURRET REPAIR SPECIAL TOOLS, and USES AND CARE OF A TORQUE WRENCH
- IMI = USE AND CARE OF TORQUE WRENCHES, MEASURING DEVICES, and JSEP GRAPHICS

TORQUE WRENCH TYPES:
Deflecting beam
Rigid case, dial indicating
Adjustable value, snap-action, Impulse feel tee handle, ratcheting, preset (fixed value), Impulse feel
Adjustable value, snap-action, impulse feel, screwdriver
Direct reading, torque screwdriver

NOTE

The torque wrench types referenced in this TO correspond with the wrenches specified in GGG-W-686 in lieu of the types referenced in above AV and IMI productions.

6.2 HOW TORQUE IS DEFINED FOR THE OPERATOR.

When a Work Card, Technical Order, or Engineering Drawing refers to the amount of torque to be applied to a fastener, use the following examples:

- If torque is stated “96 to 104” Foot-pounds, apply torque at 100 plus or minus 4 Foot-pounds. This application of torque would require the operator to use a torque wrench with an accuracy of plus or minus 4 percent or better. The value of 100 is the “Nominal” value, or torque value.
- If torque is stated as “196 to 204” Inch-pounds, apply torque at 200 plus or minus 4 Inch-pounds. This application of torque would require the operator to use a torque wrench with an accuracy of plus or minus 2 percent or better. The value of 200 is the “Nominal” value, or torque value.
- If a Work Card, Technical Order, or Engineering Drawing states the torque requirement as “100 plus or minus 4” or as “96 to 104”, the “Nominal” value is “100”. Use the “Nominal” value as the amount of torque to be applied. Any value outside of the “Nominal” value would be considered the tolerance for the torque requirement.
- If a Work Card, Technical Order, or Engineering Drawing only states a “Nominal” torque value to apply, with no additional information (part number of torque wrench, torque range or torque accuracy), set the wrench to the Nominal value. Make sure the wrench used has an accuracy of ±4 percent or better of the Nominal value when applying clockwise torque; or ±6 percent or better of the Nominal value when applying counterclockwise torque.

6.3 TORQUE REQUIREMENTS.

CAUTION

Improper hand positioning will result in an inaccurate torque. Always apply force to the designated handle or handgrip.

NOTE

- The usable range for impulse feel torque wrenches, as well as torque screwdrivers, is 20 percent to 100 percent of full scale value unless otherwise directed by 33K-1-100-1/2 Maintenance Data Collection Codes and Calibration Measurement Summaries. If necessary, special calibrations can be requested outside of this range in accordance with TO 00-20-14, paragraph 3.3.2. Example: A torque wrench of which the lowest torquing value is 10 and the highest torquing value is 200, is considered to have a capacity of 200. The lowest 20 percent of this capacity would be 40, (20 percent of 200). Normal use of this wrench must be limited to values of 40 through 200. Preset torque wrenches or torque screwdrivers that are not adjustable by the user may be used at torque settings lower than 20 or 25 percent of rated capacity limits if they have been properly certified for that torque setting.

- Prior to the use of any torque device that has a breakaway feature (includes torque screwdrivers which may have multiple break points as the handle is rotated 360 degrees), the torque device to be used must be cycled through the breakaway torque as recommended in the manufacturer's brochure. If the manufacturer's brochure is not available, set the torque device at the maximum setting and cycle through the breakaway torque at least six times. This can be accomplished by (typical example) securing the square tang of the wrench in a smooth jawed vise. This breakaway exercise can be performed at the beginning of a work shift or any time subsequent, however, it is not required more than once each shift (normally eight hours) on the specific torque wrench or wrenches to be used. The purpose of the breakaway procedure permits special internal lubricant to recoat internal working parts, eliminating internal resistance to give the most accurate reading possible.

- Large torque wrenches (150 Foot-pounds and over), may be exercised at the torque value they will be used at, rather than their maximum setting.

- Prior to the use of any digital torque device, user must exercise device at its maximum set point as recommended in the manufacturer's brochure. If the manufacturer's brochure is not available, set the torque device at the maximum setting and exercise at least three times. This is necessary to fully exercise the stress/strain gages that are present in digital torque devices.

In all torque requirements, the desired torque value is predetermined and may be found in the applicable end item overhaul manual, or in the case of standard AN and MS bolts and nuts, in Table 5-1.

6.4 IMPULSE FEEL TYPE WRENCH.

CAUTION

- Do not make any wrench adjustments to settings lower than the equivalent of one incremental division lower than the lowest torque setting on the wrench assembly.
- Do not exceed applied torque on a wrench beyond the breakaway torque that the wrench is adjusted to. Do not use a torque wrench to apply a greater amount of torque than the rated capacity of the tool.
- The only extensions that may be used on torque wrench handles are to the manufactured extensions that are supplied as a part of the torque wrench assembly.
- When an adjustable value torque wrench is stored or removed from service, set it to its lowest increment torque value or mechanical stop, whichever comes first (not applicable for digital torque wrenches). Extreme care should be exercised when changing setting to lowest increment reading on wrench to prevent shearing of internal stop pins and possible disengagement of the internal mechanism.
- Due to the chance that impact loads might be involved at the time when release occurs, manually operated torque wrenches should not be used in breaking loose previously tightened nuts and bolts unless the torque wrench used is especially designed for this purpose.
- Do not use an offset extension with a T-handle or screwdriver type torque wrench. The use of offset extensions with these type torque wrenches will result in an incorrectly applied torque.
- Universals and universal sockets shall only be used for assembly. Universals and universal sockets will not be used for final torque unless specifically directed by technical data, or if a universal is permanently attached to the torque wrench when the torque wrench is calibrated. Torque applied using a universal at varying angles will apply incorrect torque on affected hardware.
- A Foreign Object Damage (FOD) hazard may occur if the fusible plug or lead tape used to cover calibration access holes become chipped, damaged or lost.

NOTE

A fast or jerky motion will result in an improperly torqued fastener.

On an impulse feel type wrench, to set the torque handle to the selected value, unlock, and adjust to the desired setting on the scale, then relock. Install required wrenching attachment on the square drive of the handle. Note: the direction of the calibrated TMDE certification label for calibrated direction of torque. Apply the wrench assembly to the fastener to be torqued and push or pull with a smooth and steady motion. When the torque applied reaches the predetermined torque setting of the handle, the handle will automatically release or “break” producing from approximately five (5) to 10 degrees free travel. This release is distinct, is easily detected by mechanic, and indicates completed torquing action on the fastener.

6.5 USE OF AN EXTENSION ON A TORQUE WRENCH.

(See Figure 6-1 through Figure 6-3). Whenever possible, the use of extensions on torque wrenches should be avoided; however, where the use of extensions is necessary torque wrench settings can be accurately calculated, as follows:

- A - Extension length between center of broached ends measured as shown in Figure 6-1 through Figure 6-3. Use the effective length of the extension which must be measured along the centerline of the torque wrench.
- B - Wrench length between center of drive plug to approximate center of hand grip.
- T - Torque required on nut or bolt.
- S - Torque wrench setting or reading (to be calculated).

6.6 CALCULATIONS WHEN EXTENSIONS ARE USED.

Calculations applicable to use of extension are as follows:

NOTE

After determining correct torque, round decimals to the nearest whole number. Round up when 0.50 or higher. Round down when 0.49 or lower.

a. When wrenches are used similar to Figure 6-1 the equations is:

$$S \text{ equals } \frac{T \times B}{B + A}$$

b. When extensions are perpendicular to wrench handles, similar to Figure 6-2, then:

$$S \text{ equals } T$$

c. When wrenches are attached similar to Figure 6-3, the equation is:

$$S \text{ equals } \frac{T \times B}{B - A}$$

6.7 TORQUE WRENCH ADAPTER.

CAUTION

- When using wrench extensions along with above equations, torque forces exerted must be perpendicular to wrench handles.
- These torque wrench adapters must have their calibrated torque loads either etched onto them or shown on label stick-on tape applied to them and they must not be subjected to compressive forces while they are being used.

Use of torque wrench adapters similar to Belknap, Part Number (PN) 38A, and X-4 Corp., PN 38A1 (National Stock Number (NSN) 5120-01-003-2366), that are not offset (attached onto wrenching sockets) does not require use of any calculations equations regardless of lengths of wrench handles or extension adapters used with it. The PN 38A and PN 38A1 adapters are guaranteed by the manufacturer to have a reliable, useful range of 24 to 180 Inch-pounds. Therefore, general treatment of conventional torque wrenches where lower 20 percent of maximum torque rating is unreliable, does not apply to the adapter, torque limiter.

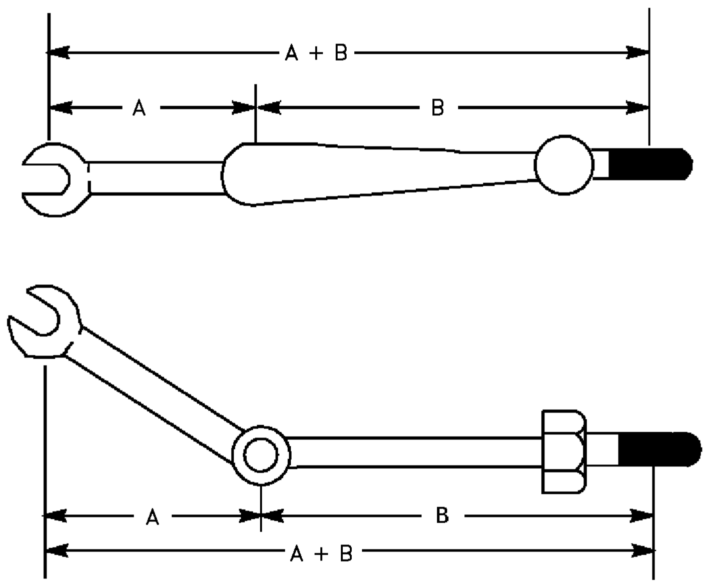

Figure 6-1. Extension Used When Total Length Exceeds Handle Length

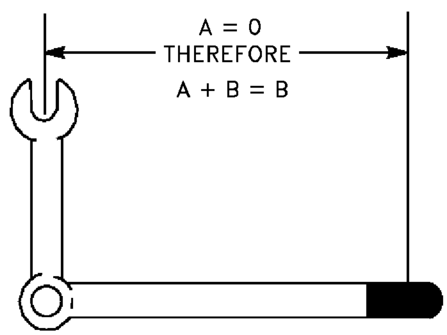

Figure 6-2. Extension Perpendicular to Wrench Handle

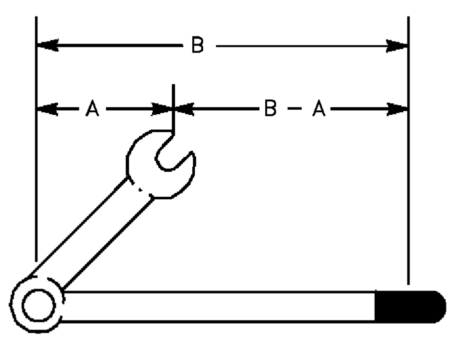

Figure 6-3. Extension Used When Total Length is Less Than Handle Length

6.8 OFFSET EXTENSIONS.

CAUTION

When using a crowfoot on a torque wrench capable of Clockwise (CW) and Counterclockwise (CCW) torquing, certain orientations of the torque wrench drive, the crowfoot, and the fastener being torqued, can use the CCW capability of the torque wrench to torque a CW threaded fastener. Use extreme caution when torquing with a crowfoot and a CW/CCW capable torque wrench, to ensure that the torque wrench is calibrated in the actual direction of travel of the torque wrench handle during torquing. For example, this problem is most evident when using a CW/CCW capable, adjustable value, impulse feel type torque wrench, with a crowfoot attached, and the torque wrench is calibrated in the CW direction only. If clearance to move the torque wrench becomes a problem and the torque wrench is removed, the barrel rotated 180 degrees, and then the crowfoot is reattached to the fastener to complete the torquing task, the uncalibrated CCW capability of the wrench can be inadvertently used to complete the CW torquing task.

If the use of offset wrenches such as crowfoot attachments where this offset could be considered as being a short extension, calculations must be made using the appropriate equation to determine wrench torque setting for assurance of accuracy of torque exerted.

NOTE

When a standard crowfoot attachment is used on a torque wrench, no torque correction is required. Torque to specified value or, if applicable, to center of specified range.

6.9 PREVAILING (RUNNING) TORQUE.

To obtain the correct recommended torque value on a nut, the nut must be run down until it is one turn from the beginning of seating. At this point, the prevailing torque should be noted. If the prevailing torque is less than one-third of the recommended torque, it should be disregarded and the nut tightened to the recommended torque value. If the prevailing torque is one-third or more than one-third of the recommended torque, it should be added to the recommended torque. Example: The recommended torque is 50 to 70 Inch-pounds. The prevailing torque at one turn from the beginning of seating is 30 Inch-pounds. The correct torque wrench reading would be 80 to 100 Inch-pounds. If the prevailing torque had been 10 Inch-pounds, it would have been disregarded and the correct torque wrench reading would have been 50 to 70 Inch-pounds.

NOTE

- Prevailing torque is usually associated with self-locking screws and nuts.
- It is not always necessary to account for prevailing torque. If the appropriate technical order specifies using a self-locking screw or nut and does not state that prevailing should be compensated for, it must be assumed that the manufacturer of the item has already taken it into consideration. As a result, prevailing torque will be compensated for only if required by specific technical data.

CHAPTER 7
MAINTENANCE AND ADJUSTMENT

7.1 ROUTINE MAINTENANCE.

Beyond the normal care of Test Measurement and Diagnostic Equipment (TMDE), there are no special requirements for torque devices.

7.2 CALIBRATION.

CAUTION

If a torque device is dropped or otherwise abused, it shall be calibrated prior to further use.

The user is responsible for obtaining calibration whenever a torque device is issued from supply or stock, and at the intervals specified by TO 33K-1-100. Calibration procedures have been removed from TO 32B14-3-1-101 and have been placed in TO 33K6-4-2193-1 for Action, Impulse Feel Torque Wrenches; TO 33K6-4-3014-1 for Torque Screwdrivers; TO 33K6-4-3015-1 for Dial Indicating and Deflecting Beam Torque Wrenches; TO 33K6-4-3016-1 for Torque Multipliers, Limiters, and Limiting Devices; and TO 33K6-4-3017-1 for Torque ‘‘T’’ Handles. Any of these technical orders may be obtained from Air Force Metrology and Calibration Program (AFMETCAL) Detachment 1/MLLW, 813 Irving-Wick Drive West Ste 4M, Heath Ohio 43056–6116. (DSN 366–5173, FAX: 366–5020).

7.3 USER ADJUSTMENTS.

There are no internal user adjustments for torque devices.

7.4 CALIBRATION ADJUSTMENTS.

Calibration adjustments are only to be accomplished during calibration by a qualified technician.

7.5 ACCESS TO CALIBRATION ADJUSTMENT ON IMPULSE FEEL TYPE WRENCHES.

Type III torque wrenches that are equipped with metal torque adjustment handles are frequently equipped with fusible plug access to calibration adjustments. These fusible plugs are located on extreme outer ends of wrench handles.

NOTE

Several screwdrivers and other type torque wrenches have exposed calibration adjustments holes which may be covered after calibration is complete. Positive sealing of these holes by use of torque seal, remelting fusible plug, lead tape, or placing a NOTICE CERTIFICATION VOID WHEN SEAL IS BROKEN label over the adjustment access is acceptable. The aforementioned positive sealing methods are examples; however, any other positive sealing methods may be used. The sealing method will be of sufficient security to detect tampering with TI (calibration) adjustment. Only qualified technicians may remove this seal. If tampering is detected, sealing is required for all torque TMDE calibrated by the Precision Measurement Equipment Laboratory (PMEL) for that Owning Work Center.

7.6 FUSIBLE PLUG REMOVABLE.

Fusible plugs may be melted out by using a low-heat soldering iron.

7.7 FUSIBLE PLUG REINSTALLATION.

If fusible plug is to be reinstalled after calibration procedures are complete, the wrench handle must be held in an upright position, the metal disc must be placed on top of the adjustment or locking screw and by using the low-heat soldering iron the fusible material can then be remelted and reformed in its original shape and position.

NOTE

Some torque devices, notably several small torque screwdrivers may require a sealant on the handle and do not lend themselves to use of the preferred lead/tin/bismuth/cadmium alloy. In these cases other sealant materials can be used. Two such materials are: Torque seal and sealing wax. The torque seal is quite easy to apply. It comes in a liquid form and drys in 24 hours. The sealing wax come in hard sticks, usually packaged in one pound boxes of 20 sticks. It is a little more difficult to apply, a heat gun may be used to melt it, but it drys almost immediately.

7.8 BELKNAP TORQUE WRENCH ADAPTER (NSN 5120-01-003-2366).

Access to the torque adjustment nut is obtained by removing a snap ring and the removing a locking plate. After torque adjustment and checking, reinstall the locking plate and the reinstall the snap ring.

7.9 JS TOOL COMPANY TORQUE WRENCHES.

Access to and torque adjustment of JS Tool Company torque wrenches are accomplished by using the following steps:

NOTE

Adjustment tools, applicable to JS Tool Company drawing T51000 can either be locally manufactured or procured from JS Tool Company by using local procurement procedures. This drawing is available at WR-ALC/LKJTC.

a. Adjust the wrench to its lowest reading.

b. Melt out the fusible plug from the side of the hand grip with a soldering iron (save the fusible alloy for reuse) or if sealed with torque seal, sealing wax or similar substance, use appropriate tool to remove it.

c. Remove the knob retaining screw or rollpin that secures the knob assembly in place and remove the knob assembly by pulling it out. Removal of the rollpin can only be accomplished by pulling it out. In wrenches (with “B” handle) that are equipped with a second knob retention screw, access for removal of the second screw can be accomplished by sliding the grip toward the drive end of the wrench. If the crystal protrudes out, push it back into the grip.

d. Attach the wrench to the torque tester and take several readings. Notice the approximate average differences of the torque wrench readings and the tester torque readings and if these differences are high or low from the tester torque readings.

e. Adjust the wrench setting to the lowest torque value that recalibration will be accomplished on.

f. Using tools in accordance with JS Tool Company drawing T51000 adjust wrench as follows:

   (1) Insert the spanner wrench into the slots of the scale drum.

   (2) Insert the socket inside the spanner onto the locknut that is within the wrench.

   (3) While keeping the spanner wrench from turning, loosen the locknut.

   (4) Turn scaled drum to compensate for difference noted in above Paragraph 7.9, Step d. (for example if the wrench readings were two (2) Inch-pounds to low, advance the scale drum to two Inch-pounds higher value).

   (5) While holding the scale drum in this position with the spanner wrench, retighten the locknut.

g. Recheck torque wrench readings for all torque readings required for recalibration. If additional adjustment is required, repeat Paragraph 7.9, Step f. and the first sentence of this step.

h. Reassemble the knob assembly with its retention screw(s) or rollpin(s).

i. Check a few intermediate settings and the highest wrench setting. These settings should now be within tolerance. If some of these settings are out of tolerance some internal components may need replacing before the wrench can be calibrated.

NOTE

A small correction to the higher readings may be made by adjusting the low reading off the nominal but within the allowable tolerance.

j. If fusible plug is to be reinstalled after calibration procedures are complete, replace fusible plug removed in Paragraph 7.9, Step b, and seal plug with torque seal, sealing wax or similar substance which will prevent loss but will not prevent removal of plug for future adjustments.

7.10 CONSOLIDATED DEVICES INCORPORATED TORQUE WRENCHES.

Access to and torque adjustment of Consolidated Devices Incorporated (CDI) adjustable torque and torque screwdrivers are accomplished by using the following steps:

7.10.1 Adjusting:.

a. The wrench needs adjusting if the handle setting reads differently than the tester reading by ±4 percent or stated Manufacturer's Specifications.

NOTE

Example: Tester reads 34 Foot-pounds. and handle on torque wrench is set at 30 Foot-pounds.

b. Remove the button plug (H) with a small blade screwdriver to expose the 1/8 inch hex set screw.

c. To correct the setting follow the following procedure using Figure 7-1.

(1) With the handle in the locked position (forward) position turn the setscrew (F) two revolutions counterclockwise this will disengage the internal mechanism of the hex assembly.

(2) Pull the handle (A) straight line to the rearmost position. Turn the handle four graduations clockwise until the handle is set at 34 Foot-pounds.

(3) With the handle set at 34 Foot-pounds, push the handle forward to the locked position, and tighten the setscrew (F).

(4) Pull the handle to the rearmost position and turn counterclockwise four graduations. Now the wrench will read 30 Foot-pounds.

(5) Slide the handle forward to the locked position and test three more times. The average of these three readings must fall within 4 percent of the wrench setting (if not, repeat Paragraph 7.10.1).

(6) If the readings fall within the allowable range, pull the handle to the rearmost position (unlocked) and turning the handle clockwise until the torque setting is at 60 percent of the scale. Lock the handle and repeat the test procedure by taking three readings at the setting. Record the average of the three readings.

(7) Following the above Paragraph 7.10.1, Step c(6) procedure, set the handle to 100 percent of the scale and record the average of the three readings at 100 percent of the scale.

(8) Check the torque wrench at all torque values applicable and if further adjustments are needs with the wrench, set at a torque value where is it out of tolerance, repeat Paragraph 7.10.1, Step c(1) through Paragraph 7.10.1, Step

c(7) and follow by rechecking at all torque values applicable. Continue to Paragraph 7.10.1, Step c(9) and seal plug with torque seal, sealing wax or other similar substance that will prevent loss, but will not prevent later removal of plug for future adjustments.

(9) Some wrenches are equipped with an additional fulcrum adjustment located under a protective label between the handgrip and the driving end of the wrench. This fulcrum adjustment is provided for high torque ranges and may be used if the wrench cannot be adjusted by the above procedure. To use this adjustment, set the wrench at either 80 percent or 100 percent of its torque range and proceed as follows:

(a) Remove protective label.

(b) Loosen fulcrum setscrew.

(c) Slightly move the fulcrum (fulcrum movement toward the drive will increase true torque and movement away from the drive will decrease this torque).

(d) Securely tighten fulcrum setscrew.

(e) Repeat Paragraph 7.10.1, Step c(9).

(f) Reinstall or replace protective label.

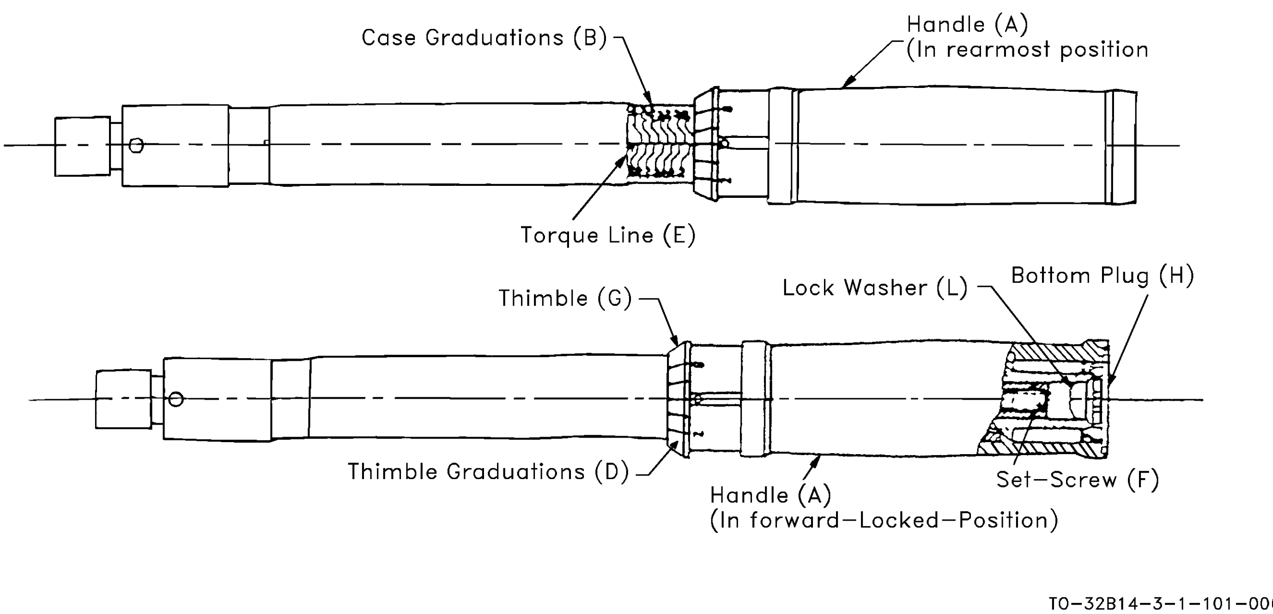

Figure 7-1. Access/Torque Adjustment of CDI Torque Wrenches