SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS28431

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Aerospace Signaling Torque Wrenches

1. SCOPE AND CLASSIFICATION:

1.1 Scope:

This Society of Automotive Engineers (SAE) Aerospace Standard covers requirements for micrometer adjustable, feel impulse, torque wrenches. The torque wrench is used to apply a pre-set torque to threaded fasteners and other torque requirements.

1.2 Classification:

Torque wrenches covered by this specification shall be one of the following types and classifications, as specified.

Type I Bi-directional torque wrench

Class 1 Non-ratchet head (precise clockwise torque)
Class 2 Ratchet head (precise clockwise torque)
Class 3 Non-ratchet head (precise counter-clockwise torque)
Class 4 Ratchet head (precise counter-clockwise torque)
Class 5 Changeable head (precise clockwise torque)
Class 6 Changeable head (precise counter-clockwise torque)

Type II Uni-directional torque wrench

Class 1 Non-ratchet head (precise clockwise torque)
Class 2 Ratchet head (precise clockwise torque)
Class 3 Non-ratchet head (precise counter-clockwise torque)
Class 4 Ratchet head (precise counter-clockwise torque)
Class 5 Changeable head (precise clockwise torque)
Class 6 Changeable head (precise counter-clockwise torque)

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1.2.1 Class Accuracy: Type I bi-directional torque wrenches shall have an accuracy of ±4% in the precise torque direction, and ±6% in the opposite direction. Type II uni-directional torque wrenches shall have an accuracy of ±4% in the precise torque direction, and shall not signal in the opposite direction.

1.2.2 Accuracy: Torque accuracy is defined as the difference between the applied torque and the pre-set torque divided by the pre-set torque expressed as a percentage.

2. APPLICABLE DOCUMENTS:

2.1 The following documents form a part of this standard to the extent specified herein. Where conflicts occur between this standard, and specified documents, this standard shall take precedence.

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS4984 Coating Requirements for Aerospace Hand Tools

2.1.2 ASTM Publications: Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials, Standards Methods of Test for

2.1.3 ASME Publications: Available from ASME, 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900.

ASME B107.4 Driving and Spindle Ends for Portable Hand, Air, and Electric Tools
ASME B107.10M Handles and Attachments for Hand Socket Wrenches - Inch and Metric Series
ASME B107.17M Gages, Wrench Openings, Reference

3. REQUIREMENTS:

3.1 Torque Wrench:

The torque wrench shall have an accurate micrometer-type, presetting mechanism upon which the required torque can be hand set by adjusting the mechanism. The torque wrench shall have a locking mechanism which holds the pre-set torque securely during use of the torque wrench. Operation of the pre-setting mechanism and locking mechanism shall not require the use of tools or equipment. The torque wrench shall have a torque signaling device that meets the requirements of 3.3.7.

3.2 Illustrations:

The illustrations herein are descriptive and are not intended to preclude the purchase of torque wrenches otherwise conforming to this specification.

3.2.1 Torque Wrench - Class 1 and 3: Class 1 and 3 torque wrenches shall be similar to Figure 1; except 500 to 2000 ft-lb capacity torque wrenches similar to Figure 2.

3.2.2 Torque Wrench - Class 2 and 4: Class 2 and 4 torque wrenches shall be similar to Figure 3.

3.2.3 Torque Wrench - Class 5 and 6: Class 5 and 6 torque wrenches shall be similar to Figure 4. Changeable heads shall be similar to Figure 5, however, connection configurations can be different than illustrated.

3.3 Design, Materials and Construction:

The torque wrench design, materials and construction shall be of uniform high quality adequate to meet the requirements of this specification and capable of providing repeated accuracy over an extended service period.

3.3.1 Handle: The torque wrench shall have a metal handle of one-piece or multi-piece design using a threaded or other mechanically fitted joint. A suitable portion of the handle shall be knurled, grooved, ribbed or provided with a non-toxic rubber cover that facilitates turning of the adjustable portion of the handle.

3.3.2 Drive Requirements Classes 1, 2, 3, 4: Torque wrenches of classes 1 through 4 shall have a male square drive with a spring-loaded steel ball which conforms to the requirements of ASME B107.4, and shall be tested in accordance with 4.11. The spring-loaded steel ball shall be located as shown in Figure 1. The male square drive hardness shall be Rockwell C 34 to 54, and shall be tested in accordance with 4.11.1. On non-ratcheting torque wrenches, two opposite flats of the male square drive shall be parallel within 5 degrees of the longitudinal axis of the torque wrench.

3.3.3 Drive Requirements Classes 5 and 6: Changeable head class 5 and 6 torque wrenches shall have changeable connection on the end of the drive tang, that allows attachment of mating drive heads. The changeable connection shall have an enclosed retaining system to prevent accidental disengagement of the changeable head during normal use. The drive tang hardness shall be Rockwell C 34 to 54 and shall be tested in accordance with 4.11.1.

3.3.4 Changeable Head Requirements Class 5 and 6: Square drive changeable heads shall conform to the requirements of ASME B107.4M and shall be tested in accordance with 4.11. Ratcheting changeable heads shall meet the requirements of 3.3.5. Open end, flare nut, and box changeable heads shall meet the dimensional requirements of ASME B107.17M and shall be tested in accordance with 4.11. The changeable head shall be designed so that changing one head for a different head shall not require the torque wrench to be recalibrated. The changeable head hardness shall be Rockwell C 34 to 54 and shall be tested in accordance with 4.11.1. Additionally, the maximum working torque capacity of the changeable head shall be clearly and permanently marked on the changeable head. The wrench and interchangeable head shall be supplied by the same manufacturer.

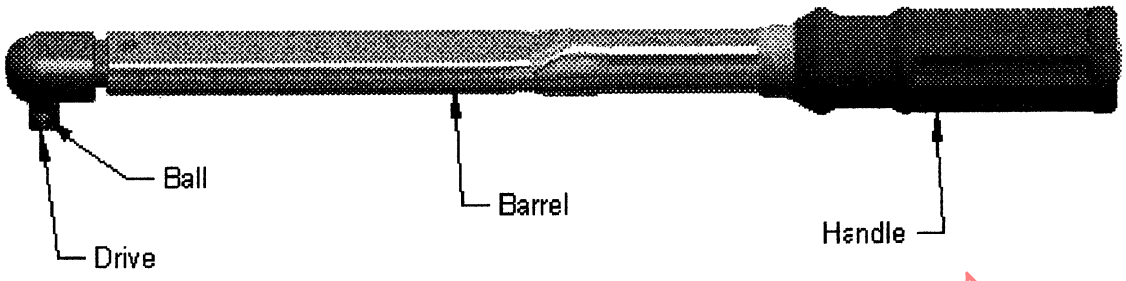

FIGURE 1 - Class 1 and 3 Torque Wrench, Micrometer Adjustable, Torque Pre-Setting, Feel Impulse, Non-Ratcheting Head

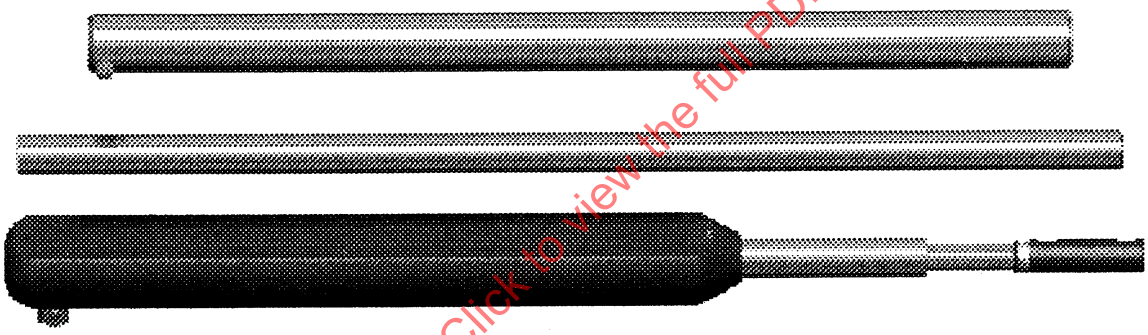

FIGURE 2 - Class 1 and 3 Torque Wrench (500 to 2000 ft-lb Capacity), Micrometer Adjustable, Torque Pre-Setting, Feel Impulse, Non-Ratcheting Head

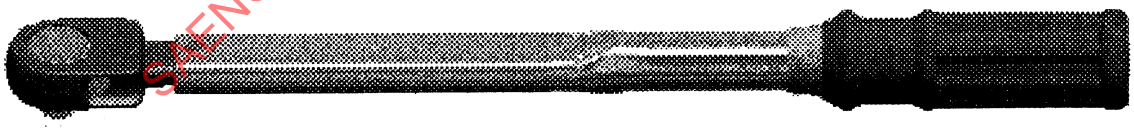

FIGURE 3 - Class 2 and 4 Torque Wrench, Micrometer Adjustable, Torque Pre-Setting, Feel Impulse, Ratcheting Head

FIGURE 4 - Class 5 and 6 Torque Wrench, Micrometer Adjustable, Torque Pre-Setting, Feel Impulse, Changeable Head

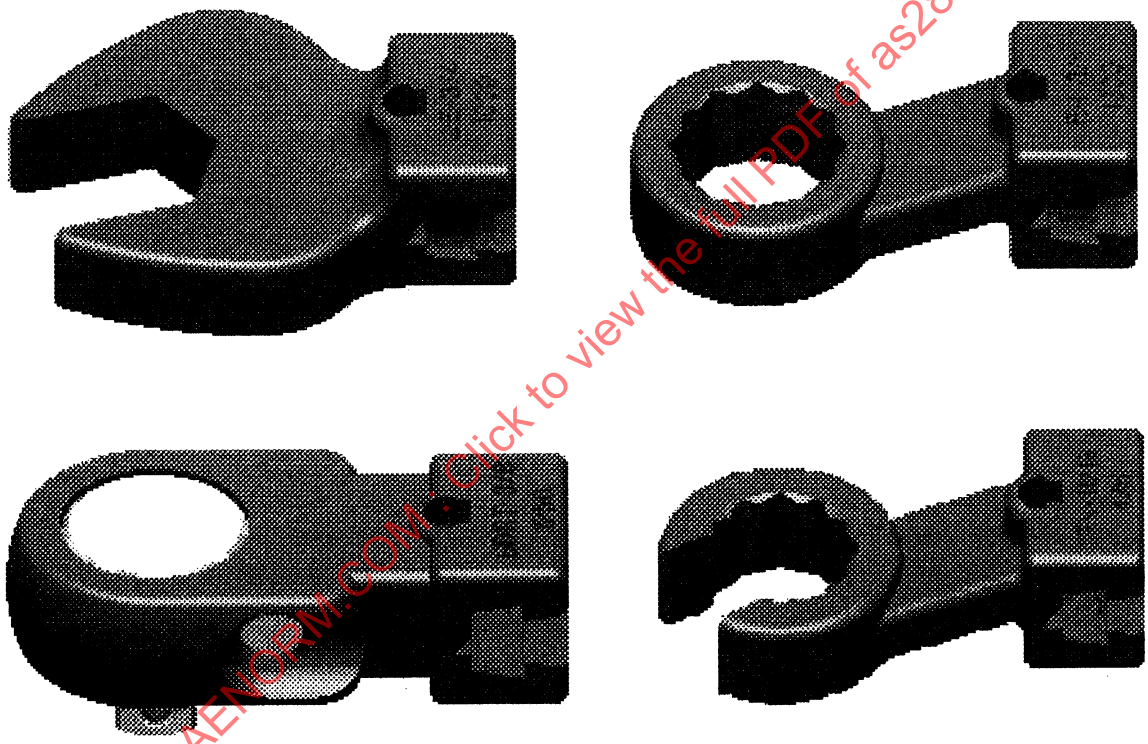

FIGURE 5 - Changeable Heads, for Class 5 and 6 Torque Wrench

3.3.5 Ratchet Requirements: Torque wrenches containing a ratchet shall be in accordance with the applicable requirements of ASME B107.10M and shall be tested in accordance with 4.12.

3.3.6 Torque Calibration/Recalibration Adjustment Mechanism: The torque wrench shall incorporate an internal mechanism which can be adjusted externally to optimize the wrench accuracy during calibration and re-calibration. Subsequent to calibration and re-calibration, the internal adjustment mechanism shall be capable of being externally sealed in a manner that prevents tampering or accidental changing of the adjustment.

3.3.7 Signal and Release Mechanism: The torque wrench shall incorporate a torque measuring device which signals by feel impulse with or without audible signal, and causes a temporary reduction in load when the pre-set torque has been reached.

3.4 Torque Scale:

The torque wrench shall have a graduated torque scale in the applicable units of torque measurement from the minimum to the maximum rated torque capacity. The torque scale shall be divided into equal graduation increments with the size of each increment equal to or less than that specified in Table 1. The graduation lines and numbers shall be cut, etched or stamped in a manner without damage to the finish or coatings. The torque wrench shall be permanently marked on the top of the torque wrench, or on the hand grip, with the units of torque measurement (e.g., ft-lb, in-lb).

3.4.1 Extended Torque Scale Markings: If the torque scale extends below the minimum or above the maximum rated torque capacity specified in Table 1, the extended scale markings shall be consistent with the scale markings throughout the rated torque capacity and in conformance with the requirements of 3.4. Extended scale markings shall only exist throughout an extended torque capacity (see 3.5.1).

3.5 Torque Capacity:

Unless otherwise specified, the torque wrench shall have, as a minimum, the applicable torque rated capacity specified in Table 1. Unless otherwise specified, the torque wrench may have an extended torque capacity (see 3.5.1). The maximum operating load applied to the center of the handgrip or to a handle extender shall not exceed the values in Table 2.

3.5.1 Extended Torque Capacity: If the torque wrench has an extended torque capacity with applicable torque scale markings below the minimum or above the maximum rated torque capacity specified in Table 1, the torque wrench shall meet all requirements of this specification, as modified (see 3.5.2), over the extended torque capacity.

3.5.2 Extended Torque Capacity Specifications: If the torque wrench has an extended torque capacity (see 3.5.1), the requirements in this specification shall be modified as follows: Substitute the lowest torque value marked on the torque wrench in lieu of the "minimum rated torque capacity", substitute the highest torque value marked on the torque wrench in lieu of the "maximum rated torque capacity", and substitute the extended torque capacity in lieu of the "rated torque capacity".

3.6 Torque Overload:

The torque wrench shall be capable of an overload of 125% of the maximum rated torque in both directions without damage, deformation, or loss of accuracy over the rated torque capacity. Subsequent to overload, the torque wrench shall, without repair or recalibration, be capable of meeting the requirements of this specification. The torque wrench overload test shall be tested in accordance with 4.8.

TABLE 1 - Signaling Torque Wrench Capacities

Rated Torque Capacity (Minimum-Maximum) in-lb	Rated Torque Capacity (Minimum-Maximum) ft-lb	Drive Size in	Increment Graduations (Maximum)	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
10-50	---	1/4	1 in-lb	x	x	x	x	x	x
30-150	---	1/4	2 in-lb	x	x	x	x	x	x
30-150	---	3/8	1 in-lb	x	x	x	x	x	x
40-200	---	1/4	1 in-lb	x	x	x	x	x	x
40-200	---	1/4	2 in-lb	x	x	x	x	x	x
40-200	---	3/8	1 in-lb	x	x	x	x	x	x
150-750	---	3/8	5 in-lb	x	x	x	x	x	x
200-1000	---	3/8	5 in-lb	x	x	x	x	x	x
360-1800	---	1/2	10 in-lb	x	x	x	x	x	x
250-2500	---	1/2	10 in-lb	x	x	x	x	x	x
600-3000	---	1/2	10 in-lb	x	x	x	x	x	x
700-1600	---	1/2	10 in-lb	x	x	x	x	x	x
1200-4800	---	3/4	40 in-lb	x	x	x	x		
---	15-75	3/8	1/2 ft-lb	x	x	x	x	x	x
---	16-80	3/8	1/2 ft-lb	x	x	x	x	x	x
---	16-80	1/2	1/2 ft-lb	x	x	x	x	x	x
---	20-100	3/8	1/2 ft-lb	x	x	x	x	x	x
---	30-150	1/2	1 ft-lb	x	x	x	x	x	x
---	40-200	1/2	1 ft-lb	x	x	x	x	x	x
---	50-250	1/2	1 ft-lb	x	x	x	x	x	x
---	60-300	3/4	5 ft-lb	x	x	x	x	x	x
---	100-500	3/4	5 ft-lb	x	x	x	x		
---	120-600	3/4	5 ft-lb	x	x	x	x		
---	140-700	1	2 ft-lb	x	x	x	x		
---	500-2000	1	10 ft-lb	x	x	x	x		

TABLE 2 - Operating Load (Force Applied at Center of Handgrip)

Drive Size in	Drive Size mm	Maximum Load lb	Maximum Load N
1/4	6.3	50	230
3/8	10	125	550
1/2	12.5	175	780
3/4	20	250	1110
1 & larger	25 & larger	300	1340

3.7 Torque Accuracy and Direction:

3.7.1 Performance: Unless otherwise specified, the torque wrench shall be capable of applying torque over the rated torque capacity with the accuracy specified in Table 3. All specified accuracy tolerance limits are absolute limits.

TABLE 3 - Torque Wrench Accuracy Tolerances

Class	Clockwise Direction	Counter-Clockwise Direction
1 & 2	±4%	±6%
3 & 4	±6%	±4%
5	±4%	---
6	---	±4%

3.7.2 Calibration Accuracy: The torque wrench shall be calibrated to meet the accuracy requirements specified in 3.7.1. The calibration shall be performed in accordance with the test requirements specified in 4.9 using test equipment that complies with the requirements of 4.10 and torque loading in accordance with 4.10.1. Subsequent to calibration, the torque wrench shall be protected against tampering by sealing the adjustment mechanism. Subsequent to sealing of the adjustment mechanism, the torque wrench shall meet the accuracy requirements specified in 3.7.1.

3.7.3 Endurance Accuracy: The torque wrench shall maintain the accuracy specified in 3.7.1 for 5000 cycles in each direction of operation at the maximum rated torque capacity or 90 days without being deformed, damaged, requiring repair, or recalibration. Subsequently, the same torque wrench shall be capable of 20,000 cycles in each direction of operation at 50% of the maximum rated torque capacity without being deformed, damaged or requiring repair; but may, if required, be recalibrated prior to accuracy testing, and shall meet the accuracy requirements specified in 3.7.1. If the torque wrench has not been operated for 90 days or more, wrench need not initially meet the accuracy requirements of 3.7.1; but shall be within ±6% accuracy in precision direction and ±8% in non-precision direction, and shall be capable, without repair, of being recalibrated to meet the accuracy requirements of 3.7.1 during the endurance period. The endurance accuracy test shall be conducted in accordance with 4.6.

3.7.4 Positional Sensitivity Accuracy: Over the rated torque capacity, the torque wrench shall meet the accuracy requirements specified in 3.7.1 with any orientation of the torque wrench with respect to gravity. The positional sensitivity accuracy test shall be conducted in accordance with 4.7.

3.8 Finish and Protective Coatings:

Cadmium plating shall not be used as an external or internal protective coating. Torque wrench internal parts subject to corrosion shall be protected by the use of lubricants or other protective coatings. Torque wrench external metal parts shall be smoothly finished and shall be protected to prevent corrosion. If chromium plating or alternative coatings are used, they shall conform to the requirements of AS4984, and shall be tested in accordance with 4.13.

3.9 Marking:

Unless otherwise specified, the torque wrench shall be permanently marked with the manufacturer's name or identifying symbol, country of origin, and unique serial number. The torque wrench shall be permanently marked on the top of the torque wrench, or on the hand grip, with an arrow or other indication of the ±4 and ±6% calibrated torque direction, as seen in Figure 6 (see Table 3). All markings shall be permanent, legible, and of adequate size for reading.

Changeable heads for class 5 torque wrenches shall be marked with the maximum torque capacity and manufacturer's name or identifying symbol. Optional markings (e.g., date code) which does not interfere with or degrade the use of the torque wrench may be included. All markings shall be cut, etched, or stamped in a manner which causes permanent deformation of the metal without damage to the finish and coatings (see 3.8). The markings shall be legible, permanent and of adequate size and contrast for reading in both daylight and artificial light.

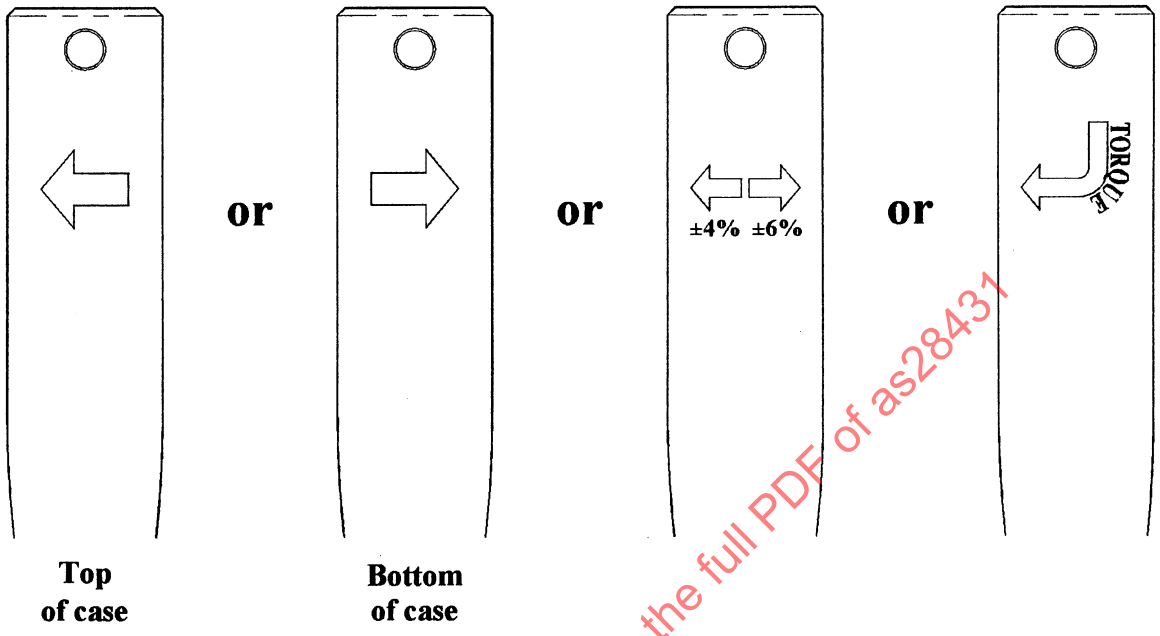

FIGURE 6

3.10 Carrying Case:

Unless otherwise specified, each torque wrench shall be provided in a carrying case. The case shall be provided with a catch which cannot be opened without disengagement of a positive latch. The case interior shall be close-fitting to accommodate the torque wrench when set at the minimum rated torque capacity and shall limit movement during shipment, handling, and storage. The case shall be of sturdy construction, sufficient to protect the torque wrench and accessories, if any, from damage during shipment, handling and storage.

3.10.1 Carrying Case Marking or Label: If specified by the customer, the outside of the top lid of the carrying case shall be permanently marked or labeled (the label shall remain affixed to the carrying case for the extended service period of the torque wrench), with the following information, including applicable units of measure.

Rated torque capacity:
Specified accuracy (CW):
Specified accuracy (CCW):
Graduation increments:
Specified drive size:
National Stock Number:
Specification:
Month and year of manufacture or
Supplier's serial number:

3.11 Instructions:

Unless otherwise specified, each torque wrench shall be packaged with a set of instructions which delineate the application, operation, recalibration, and maintenance of the torque wrench, adapters and handle extenders. The instructions shall identify the specified clockwise and counter-clockwise torque wrench accuracy and shall state that the accuracy is applicable over the torque wrench scale. If applicable, warranty information shall be provided with instructions.

3.12 Calibration Record:

Each torque wrench shall be packaged with a calibration record which delineates the manufacturer's name; contractor's assigned unique serial number, rated torque capacity, specified accuracy; date of calibration; and the actual calibration readings applicable to the torque wrench.

3.13 Workmanship:

Workmanship shall be of the highest grade throughout and equal in every respect to the best commercial practices. The torque wrench shall be free of all defects that would impair serviceability, durability, safety or appearance.

4. TEST PROCEDURES:

4.1 Responsibility for Inspection:

Unless otherwise specified the supplier is responsible for all inspection requirements as specified herein. The supplier is also responsible for insuring that materials and components used were manufactured, tested and inspected in accordance with the requirements of referenced subsidiary specifications and standards to the extent specified herein.

4.2 Test Samples:

All classes shall have two test samples for each rated torque capacity, drive size and graduation increments examined in accordance with 4.3 and tested in accordance with 4.4. The changeable head for class 5 and 6 torque wrench testing shall be square drive or ratchet of sufficient torque capacity to withstand the full scale torque of the wrench. Failure of any examination or test shall be cause for rejection.

4.3 Examinations:

4.3.1 Visual Examination: The sample torque wrench shall be examined for any nonconformance in design, material, construction, finish, coating construction, marking and workmanship.

4.3.2 Dimensional Examination: The sample torque wrench, and/or changeable head shall be examined for any nonconformance with dimensional requirements.