



<b>SURFACE VEHICLE STANDARD</b>	<b>J1237™</b>	<b>NOV2021</b>
	Issued	1978-06
	Revised	2021-11
Superseding J1237 SEP2017		
(R) Metric Thread Rolling Screws		

## RATIONALE

This SAE Standard has been revised. In this current revision, the significant changes from the previous 2017 revision include: reducing and limiting the maximum core hardness limit of Type 2 screws to 36 HRC; revising the hydrogen embrittlement testing requirements and methods (3.7.4 and 4.9) to reflect up-to-date understanding and practices related to hydrogen embrittlement; and revising the unthreaded underhead distance to establish more definitive measuring points and prevent rolling into the fillet radius.

### 1. SCOPE

This SAE Standard covers material, dimensional, performance, and test requirements for metric thread rolling screws suitable for use in general engineering applications.

#### 1.1 Requirements for Material-Process Options

- a. Screws (in sizes 2 x 0.4 through 12 x 1.75) manufactured from low carbon steel, case hardened, and tempered. These screws are designated SAE J1237 Type 2 •.
- b. Screws (in sizes 2 x 0.4 through 12 x 1.75) manufactured from medium carbon alloy steel, quench and tempered to achieve properties similar to ISO 898-1 property class 9.8 screws, and, additionally, with the point selectively induction hardened. These screws are designated SAE J1237 Type 9 •.
- c. Screws (in sizes 5 x 0.8 through 12 x 1.75) manufactured from medium carbon alloy steel, quench and tempered to achieve properties similar to ISO 898-1 property class 10.9 screws, and, additionally, with the point selectively induction hardened. These screws are designated SAE J1237 Type 10 •.

- 1.2 When SAE J1237 is specified without type designation, either Type 2 • or Type 9 • may be supplied.

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## 2. REFERENCES

### 2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

#### 2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

SAE J423                    Methods of Measuring Case Depth

SAE J864                    Surface Hardness Testing with Files

#### 2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, [www.astm.org](http://www.astm.org)

ASTM F606/F606M    Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets

ASTM F1470            Standard Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

ASTM F2328M        Standard Test Method for Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws and Studs [Metric]

#### 2.1.3 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), [www.asme.org](http://www.asme.org).

ASME B18.18            Quality Assurance for Fasteners

#### 2.1.4 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 898-1            Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel - Part 1: Bolts, Screws and Studs with Specified Property Classes - Coarse Thread and Fine Pitch Thread

ISO 1207            Slotted Cheese Head Screws - Product Grade A

ISO 1580            Slotted Pan Head Screws - Product Grade A

ISO 2009            Slotted Countersunk Flat Head Screws (Common Head Style) - Product Grade A

ISO 2010            Countersunk Slotted Raised Head Screws (Common Head Style) - Product Grade A

ISO 4014            Hexagon Head Bolts - Product Grade A

ISO 4162            Hexagon Flange Bolts - Small Series

ISO 7045            Pan Head Screws with Type H or Type Z Cross Recess - Product Grade A

ISO 7046-2	Countersunk Flat Head Screws (Common Head Style) with Type H or Type Z Cross Recess - Product Grade A - Part 2: Steel Screws of Property Class 8.8, Stainless Steel Screws and Non-Ferrous Screws
ISO 7047	Countersunk Raised Head Screws (Common Head Style) with Type H or Type Z Cross Recess - Product Grade A
ISO 7048	Cross-Recessed Cheese Head Screws
ISO 14580	Hexalobular Socket Cheese Head Screws
ISO 14583	Hexalobular Socket Pan Head Screws
ISO 14584	Hexalobular Socket Raised Countersunk Head Screws

### 3. REQUIREMENTS

#### 3.1 Material and Process Requirements - Type 2 •

##### 3.1.1 Material and Chemistry - Type 2 •

Type 2 • screws shall be made from cold heading quality, killed steel wire conforming to the chemical composition requirements in Table 1:

**Table 1 - Type 2 • - chemical composition requirements - composition limits<sup>1</sup>, % by mass**

Analysis	Carbon Min	Carbon Max	Manganese Min	Manganese Max
Cast or Heat	0.15	0.25	0.70	1.65
Product	0.13	0.27	0.64	1.71

##### 3.1.2 Heat Treatment - Type 2 •

Type 2 • screws shall be heat treated in a continuous carbonitriding or gas carburizing system. Cyaniding systems may be approved by the purchaser when a continuous flow (no batch) quenching process is employed that consistently produces uniform case and core hardness. For screw and washer assemblies in which the screw is specified Type 2 per this standard, the washer shall be rolled onto the screw after heat treatment or otherwise sufficiently masked from the carburizing atmosphere.

##### 3.1.3 Tempering Temperatures - Type 2 •

Minimum tempering temperatures shall be 340 °C.

#### 3.2 Material and Process Requirements - Type 9 • and 10 •

##### 3.2.1 Material and Chemistry - Type 9 • and 10 •

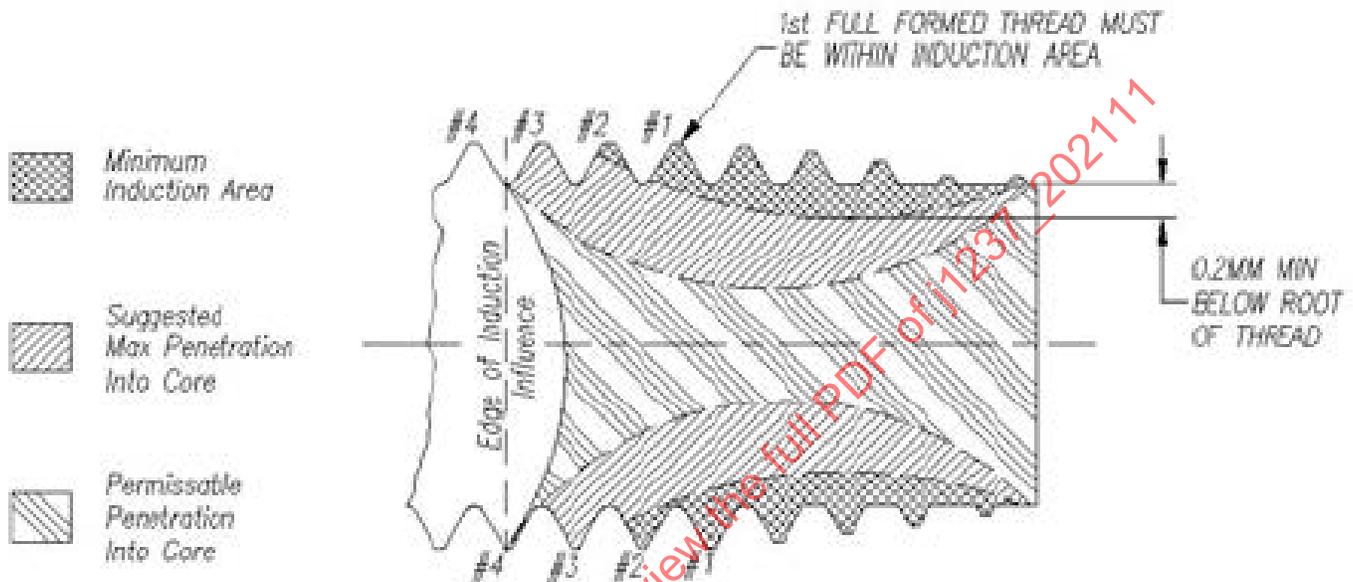
Material for Type 9 • and 10 • screws shall meet chemical composition per Property Class 10.9 per ISO 898-1.

<sup>1</sup> Boron permitted in the range of 0.0005 to 0.003.

### 3.2.2 Heat Treatment - Type 9 • and 10 •

Type 9 • and 10 • screws shall be heat treated in a continuous non-carburizing system operated under fine grain practice, oil quenched, and tempered at a minimum tempering temperature of 460 °C for Type 9 • and 425 °C for Type 10 •. Partial or complete decarburization is detrimental to thread rolling screws and is not allowed.

3.2.3 Lead threads on Type 9 • and 10 • shall be induction hardened to achieve a minimum hardness equivalent to 45 HRC (Rockwell Hardness C ) on one to three full threads and one or more lead threads, as shown in Figure 1. (File test according to SAE J864.)



**Figure 1 - Induction hardened lead threads**

### 3.3 Finish

Screws shall be furnished plain, or with a protective coating as specified by the purchaser, and meet the performance requirements specified in Table 8 for non-lubricated screws. Screws supplied lubricated, either integral with coating or supplemental, shall meet the performance requirements specified in Table 8 for lubricated screws. Screws shall be suitably treated to avoid hydrogen embrittlement in accordance with the specified finish specification.

In cases where screws are plated or coated following delivery to the purchaser (or where plating or coating of screws is otherwise under the control of the purchaser), the screw producer shall not be responsible for failures of the screw to meet mechanical or performance requirements due to plating or coating.

### 3.4 Dimensional Requirements

#### 3.4.1 Head Dimensions

Head dimensions shall conform to those specified in ISO 1207, ISO 1580, ISO 2009, ISO 2010, ISO 4014, ISO 4162, ISO 7045, ISO 7046-2, ISO 7047, ISO 7048, ISO 14580, ISO 14583, or ISO 14584.

#### 3.4.2 Thread and Point Dimensions

Thread and point dimensions shall conform to those given in Table 2. Threads shall conform to a 60-degree basic thread form. Threads are not subject to thread gaging. Details of point configuration shall be optional with the manufacturer providing all specified dimensions are maintained and screws meet the performance requirements of this document.

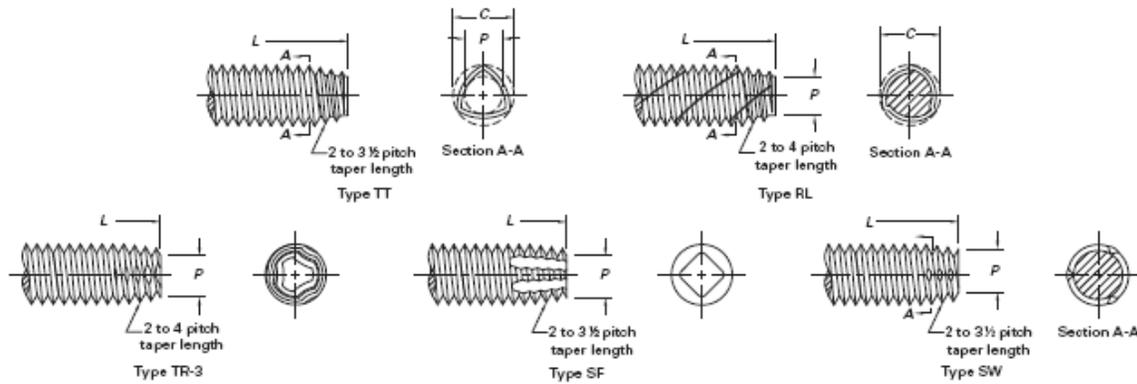


Figure 2

Table 2 - Thread and point dimensions of thread rolling screws<sup>2</sup>

Nominal Screw and Thread Pitch	Major or C Dia Max	Point or P Dia Max	Point Length Max <sup>3</sup>	Point Length Min <sup>4</sup>	L	
					Min Practical Nominal Screw Length 90-degree Heads	Min Practical Nominal Screw Length Countersunk Heads
2 x 0.4	2.06	1.67	1.4	0.8	4	5
2.5 x 0.45	2.57	2.13	1.6	0.9	4	6
3 x 0.5	3.07	2.58	1.8	1.0	5	8
3.5 x 0.6	3.58	2.99	2.1	1.2	6	8
4 x 0.7	4.08	3.40	2.4	1.4	8	10
5 x 0.8	5.09	4.40	2.8	1.6	8	10
6 x 1	6.10	5.30	3.5	2.0	10	12
8 x 1.25	8.13	7.10	4.4	2.5	10	16
10 x 1.5	10.15	9.00	5.2	3.0	13	16
12 x 1.75	12.18	10.50	6.1	3.5	16	20

### 3.4.3 Thread Length

For screws of nominal lengths within the ranges listed in Table 3, the thread shall extend to as close to the head as practical without impinging on the fillet radius, but no greater than the Y Distance measured from the underside of the head to the first scratch (the first usable indication of thread development) as shown in Figure 3. Screws longer than the nominal lengths described in Table 3, unless otherwise specified by the purchaser, shall have a minimum thread length as specified by  $L_T$  of Table 3. NOTE TO USERS: Rolling the threads too close to the underside of the head may result in interference with the fillet radius. In cases where the purchaser needs the threads closer to the underside of the head than specified above, the purchaser shall discuss and reach mutual agreement regarding feasibility with the manufacturer.

<sup>2</sup> All dimensions are in millimeters.

<sup>3</sup> These values are equal to 3.5 times the pitch distance rounded off to one decimal place.

<sup>4</sup> These values are equal to two times the pitch distance rounded off to one decimal place.

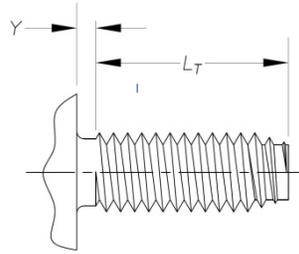


Figure 3 - Unthreaded length

Table 3 - Full form thread length and unthreaded lengths<sup>5</sup>

Nominal Screw Size and Thread Pitch	Nominal Screw Lengths >Than	$L_T$ Thread Length Min <sup>6</sup>	Nominal Screw Lengths ≤Than	Y Unthreaded Length Under Head Max <sup>7</sup>	Nominal Screw Lengths >Than	Nominal Screw Lengths ≤Than	Y Unthreaded Length Under Head Max <sup>8</sup>
2 x 0.4	16	12.0	6	0.40	6	16	0.8
2.5 x 0.45	20	15.0	8	0.45	8	20	0.9
3 x 0.5	25	18.0	9	0.50	9	25	1.0
3.5 x 0.6	30	21.0	10	0.60	10	30	1.2
4 x 0.7	35	24.0	12	0.70	12	35	1.4
5 x 0.8	40	30.0	15	0.80	15	40	1.6
6 x 1	45	38.0	18	1.00	18	45	2.0
8 x 1.25	45	38.0	24	1.25	24	45	2.5
10 x 1.5	45	38.0	30	1.50	30	45	3.0
12 x 1.75	50	38.0	36	1.75	36	50	3.5

### 3.5 Mechanical Requirements - Type 2 • Screws

#### 3.5.1 Hardness - Type 2 • Screws

##### 3.5.1.1 Core Hardness Type 2 • Screws

Type 2 • screws shall have a core hardness of 28 to 36 HRC when tested as specified in 4.1.

##### 3.5.1.2 Case Hardness Type 2 • Screws

Type 2 • screws shall have a case hardness of 45 to 53 HRC when tested as specified in 4.2.

<sup>5</sup> All dimensions are in millimeters.

<sup>6</sup> Tabulated values through 5 mm size are equal to six times basic screw diameter rounded to nearest millimeter.

<sup>7</sup> Tabulated values are equal to one times thread pitch.

<sup>8</sup> Tabulated values are equal to two times thread pitch.

## 3.5.1.3 Total Case Depth Type 2 • Screws

Type 2 • screws shall have a total case depth conforming to Table 4, when tested as specified in 4.3.

**Table 4 - Type 2 • - total case depth**

Nominal Size	Total Case Depth, mm	Total Case Depth, mm
	Min	Max
2 through 3.5	0.05	0.18
4 and 5	0.10	0.23
6 through 12	0.13	0.28

## 3.5.2 Tensile Strength Type 2 • Screws

Type 2 • screws are not subject to tensile testing.

**Table 5 - Mechanical requirements for Type 2 • thread rolling screws**

Basic Dia and Thread Pitch (mm)	Min Torsional Strength N•m
2 x 0.4	0.7
2.5 x 0.45	1.2
3 x 0.5	2.2
3.5 x 0.6	3.5
4 x 0.7	5.2
5 x 0.8	10.5
6 x 1	17.7
8 x 1.25	43.0
10 x 1.5	87.0
12 x 1.75	152.0

## 3.5.3 Torsional Strength Type 2 • Screws

Type 2 • screws shall not fail with the application of a torque less than the minimum torsional strength specified in Table 5 when tested in accordance with 4.5.

## 3.5.4 Ductility Type 2 • Screws

Heads of screws shall not separate from the shank when a permanent deformation is induced between the plane of the under head bearing surface and a plane normal to the axis of the screw, when tested in accordance with 4.8.

## 3.6 Mechanical Requirements - Type 9 • and 10 • Screws

3.6.1 Type 9 • and 10 • screws shall conform to the mechanical requirements specified in Table 6 when tested according to wedge tensile and hardness procedures published in ASTM F606/F606M.

**Table 6 - Mechanical requirements Type 9 • and 10 • screws**

Type	Wedge Tensile Strength (Stress) MPa <sup>9 10</sup>	Surface Hardness HR15N, Max	Product Hardness Rockwell <sup>11</sup>
9 •	900 min	See note <sup>12</sup>	27-36 HRC
10 •	1040 min	See note <sup>13</sup>	33-39 HRC

**Table 7 - Tensile strength values - Type 9 • and 10 • screws**

Nominal Thread Dia and Thread Pitch	Type 9 • Min Tensile Strength kN	Type 10 • Min Tensile Strength kN
2 x 0.4	1.86	
2.5 x 0.45	3.05	
3 x 0.5	4.53	
3.5 x 0.6	6.10	
4 x 0.7	7.90	
5 x 0.8	12.8	14.8
6 x 1	18.1	20.9
8 x 1.25	32.9	38.1
10 x 1.5	52.2	60.3
12 x 1.75	75.9	87.7

3.6.2 Type 9 • and 10 • screws shall conform to Class 3/4H decarburization limits as described in ASTM F2328M.

3.6.3 Ductility - Type 9 • and 10 • Screws

Heads of screws shall not separate from the shank when a permanent deformation is induced between the plane of the under head bearing surface and a plane normal to the axis of the screw, when tested in accordance with 4.8.

3.7 Performance Requirements - Types 2 •, 9 •, and 10 •

NOTE: The performance requirements covered in this document apply only to the combination of laboratory conditions described in the testing procedures. If other conditions are encountered in an actual service application (such as different materials, thicknesses, hole sizes, etc.), values shown herein for drive torque, torque-to-clamp load, and proof torque may require adjustment.

<sup>9</sup> Wedge tensile strength values for full size products are specified in Table 7. Wedge tensile strengths are applicable only to screws which have lengths equal to or longer than 12 mm or 3 times the nominal diameter, whichever is longer. Screws with shorter lengths or screws with head styles which are weaker than the threaded section are not subject to wedge tensile testing.

<sup>10</sup> Tensile wedge angles: 6 degrees when screws are threaded one nominal diameter or closer to the head; 10 degrees on all others.

<sup>11</sup> Minimum product hardness values applicable to screws not subject to tensile tests, and these hardness requirements exclude induction hardened zone 3.2.3 and Figure 1.

<sup>12</sup> Surface hardness shall not exceed product hardness by more than 3 points Rockwell C equivalent.

<sup>13</sup> Surface hardness shall not exceed product hardness by more than 3 points Rockwell C equivalent, and also shall not exceed Rockwell 15N 80, except as noted in 3.2.3 and Figure 1.

### 3.7.1 Drive Torque

Screws shall, without deforming their own thread, form a mating internal thread in a test plate with the application of a torque not exceeding the drive torque specified in Table 8 for the applicable screw size and finish, when tested in accordance with 4.6.

### 3.7.2 Torque-to-Clamp Load

Upon request by purchaser, screws subject to tensile test, 4 x 0.7 size and larger, shall develop the clamp load specified in Table 8 with the application of a torque not exceeding the clamp load torque specified in Table 8 for the applicable screw size and finish, when tested in accordance with 4.7. Smaller sizes of screws and screws not subject to tensile test are not subject to torque-to-clamp load requirements.

### 3.7.3 Proof Torque

Screws with head styles subject to tensile test shall withstand without failure the proof torque and shall be capable of being removed from the test plate following application of the proof torque specified in Table 8 for the applicable screw size and finish, when tested in accordance with 4.7. Screws not subject to tensile test are not subject to proof torque requirements.

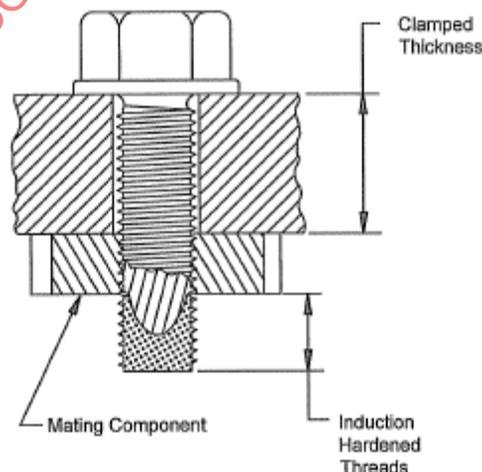
### 3.7.4 Hydrogen Embrittlement

Screws manufactured in accordance with this standard are not inherently susceptible to internal hydrogen embrittlement (IHE). It is the responsibility of the manufacturer to ensure proper process controls are in-place to produce fasteners free from internal hydrogen embrittlement. If particular measures, such as baking or testing are required by the purchaser, they must be agreed upon at the time of the order. For screw and washer assemblies (SEMS) specified in this standard, hydrogen embrittlement testing is required if the washer is hardened to a hardness exceeding 39 HRC. When embrittlement testing is required and the method is not contained in the finish specification, it shall be performed in accordance with 4.9.

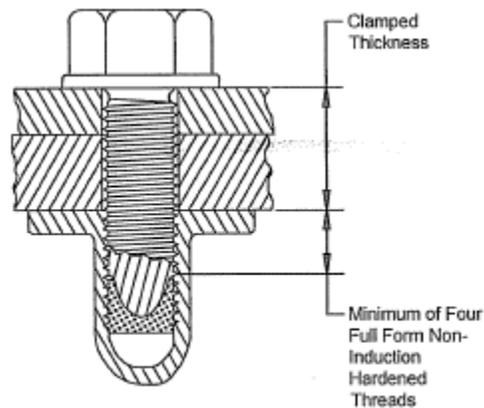
## 3.8 Application

The selectively hardened point of Type 9 • and Type 10 • screws shall extend beyond the load carrying portion of the internal threads to perform correctly. The location of the induction hardened zone shall be beyond the exit side of the mating component in a through-hole application as depicted in Figure 4 or maintain a minimum length of thread engagement equal to four full form non-induction hardened threads in a blind-hole application as depicted in Figure 5.

NOTE TO USER: It is recommended that case hardened fasteners (Type 2) not be used in structural applications.



**Figure 4 - Through-hole application**



**Figure 5 - Blind-hole application**

**Table 8 - Performance requirements - Types 2 •, 9 •, and 10 •<sup>14</sup>**

Basic Dia and Thread Pitch mm	Test Plate Thickness mm	Test Plate Pilot Hole Dia mm	Drive Torque for Lubricated Screws Max N·m	Drive Torque for Non-Lubricated Screws Max N·m	Clamp Load kN	Clamp Load Torque for Lubricated Screws Max N·m	Clamp Load Torque for Non-Lubricated Screws Max N·m	Proof Torque for Lubricated Screws N·m	Proof Torque for Non-Lubricated Screws N·m
2 x 0.4	3	1.77	0.4	0.6				0.6	0.7
2.5 x 0.45	3	2.25	0.8	1.0				1.3	1.4
3 x 0.5	3	2.7	1.3	1.7				2.4	2.5
3.5 x 0.6	3	3.15	1.9	2.4				3.7	4.0
4 x 0.7	5	3.6	2.6	3.4	3.1	4.2	4.8	5.4	5.8
5 x 0.8	5	4.55	4.8	6.0	5.0	8.0	10.0	11.0	12.0
6 x 1	6	5.4	7.5	9.2	6.9	15.0	16.0	19.0	20.0
8 x 1.25	8	7.3	16.0	20.0	12.6	34.0	40.0	46.0	48.0
10 x 1.5	10	9.2	28.0	35.0	20.0	68.0	81.0	92.0	96.0
12 x 1.75	12	11.0	46.0	55.0	29.5	110.0	130.0	160.0	170.0

#### 4. TEST METHODS

##### 4.1 Core Hardness

Core hardness shall be determined at mid-radius of a transverse section through the screw taken at a distance sufficiently behind the point of the screw to be through the full minor diameter.

##### 4.2 Surface Hardness - Type 2

Screws shall have a surface hardness of 45 to 53 HRC. For the purpose of routine testing or a quick check, the surface hardness may be checked by the use of HR15N, Knoop, or pyramid indenter. The method selected shall be dependent on the size of the product and testable area. The readings may be taken on the surface with light surface preparation. In the event that a hardness lower than specification is obtained, the referee method described as follows will prevail.

The hardness readings shall be taken 0.051 mm below the surface of the screw using a microhardness instrument with a Knoop or pyramid indenter and a 500 g load. In cases where the total depth of case is 0.10 mm or less, the reading may be taken 0.025 mm below the surface and a 100 g load is used.

<sup>14</sup> Values shown in Table 8 are intended for specification purposes and for determination of acceptability of screws to the requirements of this standard. These values are not valid for use in design or assembly unless all conditions of the application are identical with those specified for the inspection tests.