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Superseding MA1566

Gaging Practice and Gage Requirements
For MJ Metric Screw Threads

RATIONALE

MA1566A has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

1.1 Type:

This standard covers the gaging practice and gage requirements for aerospace metric screw thread, MJ profile in accordance with MA1370.

1.2 Purpose:

To establish the gaging system in accordance with ANSI/ASME B1.3M for final assessment of dimensional acceptability of the product complete thread (excluding the incomplete lead or runout thread).

1.3 Application:

The gaging practice established in this standard applies to the referee inspection of MJ screw threads, and it is not the intent of this standard to preclude the use of other gaging systems or dimensional control systems provided they are properly correlated, by the user, and yield comparable results with respect to conformance with the dimensional requirements of MA1370.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this standard to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other documents shall be the issue in effect on the date of the purchase order.

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on this Technical Report, please visit
<http://www.sae.org/technical/standards/MA1566A>**

SAE WEB ADDRESS:

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

MA1370 Screw Threads - MJ Profile, Metric
AS3062 Bolts, Screws and Studs, Screw Thread Requirements

2.1.2 ANSI Publications: Available from American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.

ANSI/ASME B1.3M Screw Thread Gaging Systems for Dimensional Acceptability - Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)
ANSI/ASME B1.22M Gages and Gaging for MJ Series Metric Screw Threads

2.2 Definitions:

INSPECTION BY ATTRIBUTES: The collective measurement of several thread elements (e.g., pitch diameter, lead, flank angle, etc.) which is denoted as a functional measurement. Inspection by attributes use limit gages (GO and NOT GO gages) or functional indicating gages, which assure that mating threads will assemble, but will not assure that each thread element is within prescribed limits of size.

INSPECTION BY VARIABLES: The measurement of individual thread elements by the use of indicating gages or other measuring instruments (optical, mechanical, pneumatic, or electrical). Inspection by variables can assure that individual thread elements are within prescribed limits of size.

3. REQUIREMENTS:

3.1 Routine Inspection (Manufacturing and Receiving Inspection):

Any gaging system or dimensional control system may be used provided they are properly correlated by the user and yield comparable results to the gaging specified under 3.2.

3.2 Referee Inspection:

In case of dispute between purchaser and supplier, the following referee gaging practice shall apply for final assessment of dimensional acceptability of the product complete threads, excluding the incomplete lead and runout threads which shall be inspected as specified in AS3062 for external threaded fasteners, unless otherwise specified on the part drawing.

3.2.1 The numerical designations shown in Tables 1 and 2 under the columns for "Attributes" and "Variables" gaging are designations assigned to the thread gages and measuring equipment listed in ANSI/ASME B1.3M, Tables 1 and 2.

3.2.2 The alphanumeric designations under "Col." in Tables 1 and 2 are only for indicating the type of measurement that is to be evaluated; that is, limit (maximum or minimum material limit) or size (effective or actual size) as designated in ANSI/ASME B1.3M, Tables 1 and 2.

- 3.2.3 Internal Thread Gaging System 22S: Table 1 specifies the internal gaging system using ANSI/ASME B1.3M designations for gaging system, gage numeric designation, and type of measurement.

TABLE 1 - Internal Thread Gaging System 22S

Dimensions Inspected	Attributes/ Fixed Limit		Variables/ Indicating	
	Control	Col.	Control	Col.
GO Maximum Material	1.1, (1.3) /1/ 4.1	A1	4.1	A2
Pitch Diameter			4.5	C2
Minor Diameter, Minimum	3.1(a), (1.3) /1/	K1		
Minor Diameter, Maximum			5.2, 9	K2
Minor Diameter Runout			4.7, 9	M
Cumulative Form Variation			4.10	E1 thru I

/1/ When specified on product drawing, FULL FORM GO thread plug gage, 1.3, is used (in lieu of GO plain cylindrical plug gage, 3.1(a), and GO thread plug gage, 1.1) for checking spin down on minor diameter and thread maximum material limit.

NOTE: When specified on product drawing, maximum major diameter is inspected by optical comparator, using silicone cast of the internal thread.

- 3.2.3.1 Internal Thread Size Limitations: Dimensional acceptability of nominal size MJ4 and smaller shall be limited to ANSI/ASME B1.3M internal thread gaging System 21 for inspection, using GO and NOT GO thread plug gages and GO and NOT GO plain plug gages. Internal threads larger than MJ150 nominal size or where the threaded part configuration presents technical or economical gaging problems, these threads shall be inspected by gaging or measuring methods agreed upon by purchaser and supplier.

- 3.2.4 External Thread Gaging System 22S: Table 2 specifies the external thread gaging system using ANSI/ASME B1.3M designations for gaging system, gage numeric designation, and type of measurement.

TABLE 2 - External Thread Gaging System 22S

Dimensions Inspected	Attributes/ Fixed Limit Control	Col.	Variables/ Indicating Control	Col.
GO Maximum Material	1.1, 4.1 4.3	A1	4.1, 4.3	A2
Pitch Diameter			4.5, 4.6 8	C2
Major Diameter	3.1(a), 3.4	J1	14	J2
Major Diameter Runout			4.7, 9	M
Root (Minor) Diameter			9	K2
Root Radius			9	L
Cumulative Form Variation			4.10	E1 thru I

- 3.2.4.1 External Thread Size Limitations: Dimensional acceptability of nominal size MJ2 and smaller shall be limited to ANSI/ASME B1.3M external thread gaging System 21 for inspection, using GO and NOT GO thread ring gages and GO and NOT GO plain ring gages. External threads larger than MJ150 nominal size or where the threaded part configuration presents technical or economical gaging problems, these threads shall be inspected by gaging or measuring methods agreed upon by purchaser and supplier.

3.3 Thread Features Inspected:

- 3.3.1 Internal Thread Gaging System 22S: The dimensional features to be inspected for System 22S conformance and the type of measurement are as follows (see Table 1):

- 3.3.1.1 GO Maximum Material: The maximum material limit of thread flanks and minimum major diameter, D, (excluding the minor diameter, D1) for a thread length equal to the basic length of thread engagement shall be inspected by one of the following gages:

- GO thread plug gage, limit type (1.1)
- FULL FORM GO thread plug gage, limit type (1.3), when specified. See 3.3.1.5 for related information.
- GO segments, indicating thread gage, functional limit and functional size (4.1)

- 3.3.1.2 Pitch Diameter, D2: Shall be a single element measurement of PD size using the cone and vee type indicating gage (4.5).
- 3.3.1.3 Major Diameter, D: The minimum major diameter is inspected by the GO thread plug gage. The maximum major diameter is inspected only when specified on the product drawing; if required, a removable silicone cast of the internal thread shall be used for optical comparator inspection (1.1, 1.3, 4.1, 9).
- 3.3.1.4 Minor Diameter, Minimum, D1: Inspection of the maximum material limit of thread crests for a thread length equal to the basic length of thread engagement shall be performed by using the following gage:
- GO plain cylindrical plug, limit type (3.1(a)).
- 3.3.1.5 Spindown on Minor Diameter: When specified on the product drawing, the FULL FORM GO thread plug gage may be used as a referee gage for acceptance of the minor diameter, as well as, the maximum material limit as in 3.3.1.1. Hence, the GO thread plug gage and GO plain plug gage are replaced by the FULL FORM GO thread plug gage in such cases (1.3).
- 3.3.1.6 Minor Diameter, Maximum, D1: Size measurement shall be measured by one of the following methods:
- Indicating plain diameter gage, minor diameter type (5.2)
 - Optical comparator with silicone case replica (9)
- 3.3.1.7 Minor Diameter (D1) Runout Relative to Pitch Diameter (D2): Shall be determined by one of the following methods:
- An indicating gage having GO length segments, one of which has GO thread plug gage profile and the other (spaced 180° apart) has a plain gage surface (4.7).
 - Or alternatively, removable silicone cast of the internal thread shall be used for optical comparator inspection (9).
- 3.3.1.8 Cumulative Form Variation: Shall be determined as follows:
- The maximum observed difference between the GO thread indicating gage reading and the single element pitch diameter measurement indicating gage reading (4.10).
- 3.3.2 External Thread Gaging System 22S: The dimensional features to be inspected for System 22S conformance and the type of measurement are as follows (see Table 2):

- 3.3.2.1 GO Maximum Material: The maximum material limit of thread flanks (excluding the major diameter, d) shall be inspected by one of the following gages:
- GO thread ring gage, limit type (1.1)
 - GO segments, indicating thread gage, functional limit and functional size (4.1)
 - GO rolls, indicating thread gage, functional limit and functional size (4.3)
- 3.3.2.2 Pitch Diameter, d_2 : Shall be a single element measurement of PD size using one of the following gages:
- Cone and vee type indicating gage (4.5)
 - Cone only type indicating gage (4.6)
 - Thread three-wire measurement (8)
- 3.3.2.3 Major Diameter, d : Maximum material of thread crests, major diameter limits, and single element size measurement shall be determined by the following methods:
- Maximum GO plain cylindrical ring (3.1(a))
 - Maximum and minimum major diameter snap type (3.4)
 - Plain micrometer single element measurement (14)
- 3.3.2.4 Major Diameter, d , Runout Relative to Pitch Diameter, d_2 : Shall be determined by one of the following methods:
- An indicating gage having GO length segments, one of which has GO thread ring gage profile and the other (spaced 180° apart) has a plain gage surface (4.7).
 - Or alternatively, optical comparator inspection (9). See 3.4.2.
- 3.3.2.5 Root (Minor) Diameter, d_3 : Shall be measured by the following method:
- Single element measurement by optical comparator inspection (9).
- 3.3.2.6 Root Radius, R : Shall be inspected by the following method:
- Single element measurement by optical comparator inspection, (9).
- 3.3.2.7 Cumulative Form Variation: Shall be determined by the following method:
- The maximum observed difference between the GO thread indicating gage reading and the single element pitch diameter measurement indicating gage reading or the 3-wire measurement (4.10).

3.4 Function and Use of Gages:

The thread gage applications and definitions are in ANSI/ASME B1.22M. The following details for optical comparator use are not included in the ANSI/ASME B1.22M.

3.4.1 Internal Thread Minor Diameter Runout, Optical Comparator:

3.4.1.1 Function: The optical comparator inspection of the minor diameter runout measures the amount of runout of the thread crests in relation to the thread axis during one revolution of a removable silicone cast representing the product internal thread.

3.4.1.2 Use: After proper setup on the optical comparator, the measuring procedure is as follows.

The axis of the silicone cast is established parallel to the screen horizontal line by aligning the major diameter image to the screen horizontal line and maintaining this alignment during one revolution of the silicone cast.

During one revolution of the silicone cast, the minor diameter image of the cast thread roots are noted for extreme upper and lower positions.

The distance between the extreme upper and lower positions, as indicated by the table vertical measuring device, is the total runout of the thread crests relative to the thread axis as represented by the silicone cast.

3.4.2 External Thread Major Diameter Runout, Optical Comparator:

3.4.2.1 Function: The optical comparator inspection of the major diameter runout measures the amount of runout of the thread crests in relation to the thread axis during one revolution of the product external thread.

3.4.2.2 Use: After the proper setup on the optical comparator, the measuring procedure is as follows.

The axis of the product external thread is established parallel to the screen horizontal line by aligning the minor diameter image to the screen horizontal line and maintaining this alignment during one revolution of the product thread.

During one revolution of the product thread, the major diameter image of the thread crests are noted for their extreme upper and lower positions.

The distance between the extreme upper and lower positions, as indicated by the table vertical vernier, is the total runout of the thread crests in relation to the product thread axis.

3.5 Gage Design Requirements:

3.5.1 Unless otherwise specified herein, the gage design shall be in accordance with ANSI/ASME B1.22M.

3.5.2 Gage tolerances and wear allowances shall be applied unilaterally within the thread product limits of size.

3.5.3 Tolerances, Working Thread Gages: The working thread gages used for the inspection of product screw threads shall be made to X tolerances.

- 3.5.4 Tolerances, Setting Thread Gages: Setting thread gages shall be made to *W* tolerances.
- 3.5.5 Tolerances, Plain Gages: Plain gages shall be made to *Z* tolerances.
- 3.5.6: The GO thread plug and ring gages, the GO plain plug and ring gages, and the GO thread indicating gaging segments or rolls shall have a gage length equal to the basic length of thread engagement as specified in Table 3.

TABLE 3 - Basic Length of Thread Engagement, Le_{bsc}

Pitch, P mm	$Le_{bsc} = 9P$ /1/ mm
0.35	3.15
0.4	3.6
0.45	4.05
0.5	4.5
0.6	5.4
0.7	6.3
0.75	6.75
0.8	7.2
1	9
1.25	11.25
1.5	13.5
1.75	15.75
2	18
2.5	22.5
3	27

/1/ $Le_{bsc} = 9P$ where the basic major diameter for standard thread series is greater than $9P$. Where basic major diameter of standard series is less than $9P$, Le_{bsc} shall equal the basic major diameter, D_{bsc} , d_{bsc} .