



AEROSPACE STANDARD

AS5870™

Issued 2010-01
Reaffirmed 2026-01

Thread Inspection Practices

RATIONALE

AS5870 has been reaffirmed to comply with the SAE Five-Year Review policy.

TABLE OF CONTENTS

1.	SCOPE.....	3
2.	REFERENCES.....	3
3.	GAGE SELECTION AND USE	6
4.	SINGLE ELEMENT PITCH DIAMETER PRODUCT ACCEPTANCE LIMITS AND GUARDBAND FACTORS	12
5.	NOTES.....	25
APPENDIX A	PRODUCT DISTRIBUTIONS AND CONSUMER RISK	26
FIGURE 1	MEASUREMENT SYSTEM FLOW CHART	7
FIGURE 2	EXAMPLE OF A BIASED PRODUCT DISTRIBUTION WITH A BIAS IN THE MEASUREMENT SYSTEM.....	10
TABLE 1	THREAD GAGING FOR EXTERNAL THREAD PRODUCT	8
TABLE 2	THREAD GAGING FOR INTERNAL THREAD PRODUCT (NOTE 1).....	9
TABLE 3	GUARDBAND FACTORS AND INSPECTION LIMITS FOR EXTERNAL THREAD UNJ COARSE SERIES PRODUCT.....	13
TABLE 4	GUARDBAND FACTORS AND INSPECTION LIMITS FOR INTERNAL THREAD UNJ COARSE SERIES PRODUCT.....	14
TABLE 5	GUARDBAND FACTORS AND INSPECTION LIMITS FOR EXTERNAL THREAD UNJ FINE SERIES PRODUCT	15
TABLE 6	GUARDBAND FACTORS AND INSPECTION LIMITS FOR INTERNAL THREAD UNJ FINE SERIES PRODUCT	16
TABLE 7	GUARDBAND FACTORS AND INSPECTION LIMITS FOR EXTERNAL THREAD UNJ EXTRA FINE SERIES PRODUCT.....	17
TABLE 8	GUARDBAND FACTORS AND INSPECTION LIMITS FOR INTERNAL THREAD UNJ EXTRA FINE SERIES PRODUCT.....	18

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2026 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, or used for text and data mining, AI training, or similar technologies, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 1-877-606-7323 (U.S. and Canada only)
Tel: 1-724-776-4970 (outside U.S. and Canada)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE AS5870

For more information on this standard, visit
<https://www.sae.org/standards/content/AS5870/>

Documents

Standard, visit Sharing Hub

TABLE 9	GUARDBAND FACTORS AND INSPECTION LIMITS FOR EXTERNAL THREAD UNJ EIGHT THREAD SERIES PRODUCT	19
TABLE 10	GUARDBAND FACTORS AND INSPECTION LIMITS FOR INTERNAL THREAD UNJ EIGHT THREAD SERIES PRODUCT	20
TABLE 11	GUARDBAND FACTORS AND INSPECTION LIMITS FOR EXTERNAL THREAD UNJ TWELVE THREAD SERIES PRODUCT	21
TABLE 12	GUARDBAND FACTORS AND INSPECTION LIMITS FOR INTERNAL THREAD UNJ TWELVE THREAD SERIES PRODUCT	22
TABLE 13	GUARDBAND FACTORS AND INSPECTION LIMITS FOR EXTERNAL THREAD UNJ SIXTEEN THREAD SERIES PRODUCT	23
TABLE 14	GUARDBAND FACTORS AND INSPECTION LIMITS FOR INTERNAL THREAD UNJ SIXTEEN THREAD SERIES PRODUCT	24

1. SCOPE

This document addresses AS8879 thread inspection issues relating to selection, usage and capability of gages. It addresses the selection of calibrated measurement gages, the need for defined quality metrics, the methodology of determining the appropriate guardband factors, and the minimum inspection requirements for single element pitch diameter gages.

Users of this document shall apply the information described herein for the evaluation of the capability of their measurements based on the measurement consumer risk. It involves the analysis of the measurement (product) distribution and biases of both the product and measurement system distributions. It protects the consumer from the worst case distribution results.

A whitepaper has been developed to provide supporting documentation and the rationale used in the development of this standard. This whitepaper will be published by the SAE as an Aerospace Information Report (AIR6553).

This document recommends the use of ASME B1.2 "Gages and Gaging for Unified Inch Screw Threads" or IFI 301 "Gage Calibration Requirements and Procedures for Thread Gages" as guides for establishing the minimum calibration requirements for all types of thread gages.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained

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 724-776-4970 (outside USA), www.sae.org.

AIR6553	Measurement Uncertainty and Consumer Risk
AS8879	Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Diameter
ARP9013	Statistical Product Acceptance Requirements

2.1.2 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME B1	Technical Report "Measurement Uncertainty for 60 degree Screw Thread Gage Element Measurement Inch and Metric"
ASME B1.2	Gages and Gaging for Unified Inch Screw Threads
ASME B1.3	Screw Thread Gaging System for Dimensional Acceptability - Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)
ASME B89.7.4.1	Measurement Uncertainty and Conformance Testing: Risk Analysis

2.1.3 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

REPORT NO: FAA-IR-01-02 - AVIATION FASTENER AUDIT FINAL REPORT JUNE 13, 2001

Available at: www.faa.gov/library/reports/media/FASTENER_AUDIT_REPORT.pdf

2.1.4 Industrial Fastener Institute Publications

Available from Industrial Fastener Institute, 6363 Oak Tree Boulevard, Independence, Ohio 44131, Tel: 216-241-1482, www.indfast.org.

IFI 301 Gage Calibration Requirements and Procedures for Thread Gages

2.2 DEFINITIONS

2.2.1 Average Outgoing Quality Limit (AOQL)

Maximum average outgoing quality over all possible values of incoming product quality level for a given acceptance sampling plan.

2.2.2 Average Outgoing Quality (AOQ)

The average quality of outgoing product after sampling inspection for a given steady value of incoming product quality.

2.2.3 Confidence Interval (CI)

The interval of a measurement result that is estimated to contain an associated percentage, as represented by the confidence level, of the distribution of possible measurement results, e.g., ± 0.0002 inch.

2.2.4 Confidence Level (CL)

The probability that a measurement result made at the time of its evaluation is within its associated confidence interval.

2.2.5 Consumer Risk (CR) (single measurand)

A numerical estimate of the probability that the true value of a measurand (for example: pitch diameter at 68 °F) falls outside a given performance specification, but is measured to be within the guardband limit.

2.2.6 Error Ratio (ER)

The ratio between the engineering tolerance and the Measurement System Error for a given measurement on the same confidence level basis.

2.2.7 Expanded Error

The sum of the measurand bias and extended uncertainty that bound the values of expected error for a given confidence level.

2.2.8 Expanded Uncertainty

The lower and/or upper confidence intervals that bound the expected values of a random variable for a given confidence level.

2.2.9 Guardband Limit (GBL)

Reduced acceptance limit that maintains the target measurement consumer risk

NOTE 1: Guardband limit, as defined here, is risk-based and is therefore consistent with the general basis of this standard.

NOTE 2: These limits are obtained by multiplying the Guardband Factor (GBF) times the Product Tolerance.

2.2.10 Initial Reliability Requirement (IRR)

The minimum probability of product conformance which the inspection procedure allows. This is an index used in defining reliability-based sampling plans.

2.2.11 Measurement Capability

The performance of a measurement system as intended to define, realize, conserve or reproduce one or more of its obtained measurement values.

2.2.12 Producer Risk (PR)

A numerical estimate of the probability that the true value of a measurand (for example: pitch diameter at a known temperature) falls inside a given performance specification, but is measured to be outside the guardband limit.

2.2.13 Quality Metric

Parameter used to define a sampling requirement, (e.g., AOQL).

2.2.14 Rejectable Quality Level (RQL)

The minimum percent defective at which a lot will have 5% or less chance of being accepted when using a sampling plan or another statistically based monitoring system.

2.2.15 Sigma Model

The performance specification divided by the number of standard deviations in the product distribution.

2.2.16 Uncertainty Ratio (UR)

The Historical Measurand Expanded Uncertainty of the product divided by the Measurement System Expanded Uncertainty for a given measurement on the same confidence level basis (for example, both 2 sigma).

3. GAGE SELECTION AND USE

3.1 Requirements

3.1.1 Applicability

Thread inspection gages shall be used in accordance with the requirements of this standard to ensure conformance to customer design documents, contracts and legal or regulatory requirements.

As allowed for in ASME B89.7.4.1, and for the purpose of this document, risk-based guardbanding is the chosen basis for ensuring a measurement process is consistent with the required measurement capability. Risk based guardbands ensure that the maximum acceptable level of consumer risk is not exceeded when determining the guardband factors based on Error or Uncertainty Ratios. ASME B89.7.4.1 establishes the boundaries of the acceptance zone based on consumer risk but does not deal with product or measurement system biases as this document does.

Consumer risk, known as the probability of a false accept and formally defined in 2.2.5, can be considered a measure of customer quality risk. Producer risk, known as the probability of a false reject and formally defined in 2.2.12, can be considered a measure of supplier cost risk. All other factors being equal, consumer risk is inversely related to producer risk as a function of guardband factor. Reducing the guardband factor has the effect of decreasing consumer risk and increasing producer risk.

Bilateral evaluations utilize risk-based guardbanding. Attribute gage evaluations satisfy the capability requirement by limiting consumer risk through proper design practice and consumer risk calibration methodology.

The following flow chart (Figure 1) depicts the measurement system for thread measurements as defined in this document.

3.1.2 Measurement requirements shall be determined from procurement specifications, engineering definition or tabulated tolerances specified in screw thread definition documents, such as AS8879.

3.1.3 The measurement procedures and gage setting intervals to be used shall be documented. The variable gage used for product conformity determination shall be set with the set master immediately before initiating inspection of a product lot and verified immediately after product lot inspection.

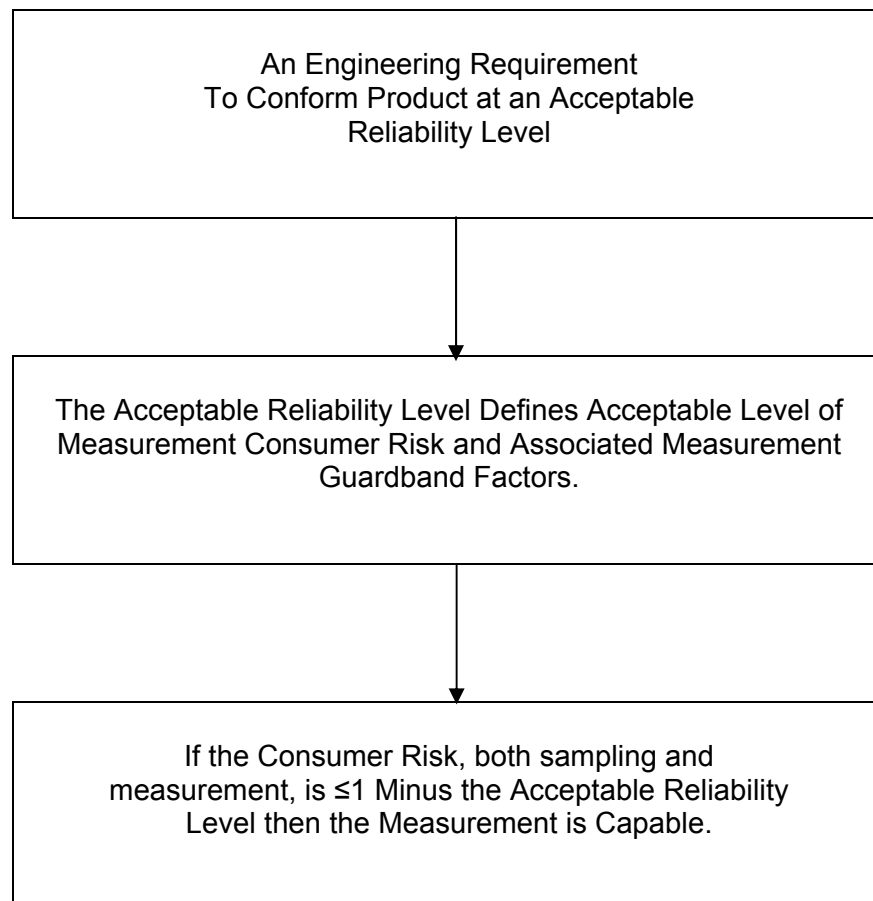
3.1.4 Gages, setting masters and product to be inspected shall be stabilized under the same environmental conditions. The stabilization period depends on the material and size of the product and gages.

3.2 Selection of Gage(s)

This process applies to measurements produced using inspection gages with traceable calibrations. This section defines the process for interpreting an inspection requirement and selecting a capable thread inspection gage.

3.2.1 Users of this process shall select thread inspection gage(s) with the capability to meet the requirements of this process. AS8879 conformance requirements and ASME B1.3 thread characteristics are referenced in Table 1 for external threads and Table 2 for internal threads. The use of any gage or inspection device is allowed as long as the gage or inspection device is shown to be capable per the requirements of this document (see 3.3).

3.2.2 Thread measurement gage(s) shall be selected for a given characteristic such that the guardband factors for the determined Error Ratio are based on Table 3 through Table 14 of this document. The formulas used to calculate the values in Tables 3 through 14 are located in Appendix A.



NOTE: Block 1 defines the measurement requirements and the acceptable capability of the measurement based on the engineering reliability requirement (Acceptable Risk).

Based on the requirement of Block 1, and for the purpose of this document, Block 2 defines the acceptable consumer risk of sampling and the measurement. These, in turn, define the required consumer based guardband factors.

Knowing the consumer based guardbands allows the user to define capable measurements.

FIGURE 1 - MEASUREMENT SYSTEM FLOW CHART

- 3.2.3 If control of lead and flank angle variation is required for threaded product (e.g., Category 2 threads), use of the variable indicating differential method is approved when full form segment gage elements are used (see Table 1, Note 3 and Table 2, Note 4). Lead and flank angle may also be measured by direct methods.

TABLE 1 - THREAD GAGING FOR EXTERNAL THREAD PRODUCT

Characteristic	Category 1	Category 2	Ref. Columns Table 1 in ASME B1.3
Major Diameter	Major Diameter shall be within specified dimensional requirements		J1 or J2
Pitch Diameter	Size (Pitch Diameter or Groove Diameter) shall be within the specified dimensional requirements		C2 or D2
	Note: Unless otherwise specified, for products with thread length less than 6 pitches (including incomplete threads), NOT GO Functional Diameter Limit Inspection is acceptable.		B1
Functional Diameter	The Functional Diameter shall be less than or equal to the envelope of perfect form at Maximum Pitch Diameter		A1 or A2 Note 1
Minor Diameter	Minor Diameter shall be within the specified dimensional requirements		K1 or K2
Root Radius	Root Radius shall be within the specified dimensional requirements		L
Incomplete Runout Threads	Note 2		Not Applicable
Incomplete Lead Threads	Note 2		Not Applicable
Surface Roughness	For reference only, Note 2	Note 2	N
Lead	For reference only, Note 2	Note 2	H Note 3
Flank Angle	For reference only, Note 2	Note 2	I Note 3
Circularity	For reference only, Note 2	Note 2	E1 or E2, and F1 or F2
Taper	For reference only, Note 2	Note 2	G1 or G2
Runout	For reference only, Note 2	Note 2	M

Note 1: If a gage with non-helical elements (e.g., gage 4.3.1 or 4.3.2 per ASME B1.3, Table 1) is used it shall be supplemented with a gage using helical thread form (e.g., gage 1.1 per ASME B1.3, Table 1). The associated measurement consumer risk of using limit gages certified to the requirements of this document is extremely small and no additional guardbanding is required.

Note 2: Reference appropriate paragraph in AS8879.

Note 3: Whenever Lead and Flank Angle variation are being controlled (e.g., Category 2 Threads), Inspection of Lead and Flank Angle variation using the variables indicating differential method may only be accomplished using full-form (helical) GO segment gage elements (ASME B1.3 Table 1, Gage 4.1.1 or 4.1.2). Use of full-form GO Rolls (Gage 4.3.1 or 4.3.2) is not permitted.

TABLE 2 -THREAD GAGING FOR INTERNAL THREAD PRODUCT (NOTE 1)

Characteristic	Category 1	Category 2	Ref. Columns, Table 2 in ASME B1.3
Major Diameter	Major Diameter shall be greater than the specified minimum		J1 or J2
Pitch Diameter	Size (Pitch Diameter or Groove Diameter) shall be within the specified dimensional requirements		C2 or D2
	Unless otherwise specified, for products with thread length less than 6 pitches (including incomplete threads), NOT GO Functional Diameter limit inspection is acceptable.		B1
Functional Diameter	The Functional Diameter shall be greater than or equal to the envelope of perfect form at Minimum Pitch Diameter		A1 or A2 Note 2
Minor Diameter	Minor Diameter shall be within the specified dimensional requirements		K1 or K2
Incomplete Lead Threads	Note 3		N/A
Surface Roughness	For reference only, Note 3	Note 3	N
Lead	For reference only, Note 3	Note 3	H Note 4
Flank Angle	For reference only, Note 3	Note 3	I Note 4
Circularity	For reference only, Note 3	Note 3	E1, E2, F1, or F2
Taper	For reference only, Note 3	Note 3	G1 or G2
Runout	For reference only, Note 3	Note 3	M

Note 1: For internal threads of nominal size less than 0.1900 inch, conformance requires inspection of only the functional diameter and minor diameter limits

Note 2: If a gage with non-helical elements (e.g., gage 4.3.1 or 4.3.2 per ASME B1.3, Table 2) is used it shall be supplemented with a gage using helical thread form (e.g., gage 1.1 per ASME B1.3, Table 2). The associated measurement consumer risk of using limit gages certified to the requirements of this document is extremely small and no additional guardbanding is required.

Note 3: Reference appropriate paragraph in AS8879.

Note 4: Whenever Lead and Flank Angle variation are being controlled (e.g., Category 2 Threads), Inspection of Lead and Flank Angle variation using the variables indicating differential method may only be accomplished using full-form (helical) GO segment gage elements (ASME B1.3 Table 2, Gage 4.1.1 or 4.1.2). Use of full-form GO Rolls (Gage 4.3.1 or 4.3.2) is not permitted.