QUALITY INSPECTION TECHNICAL MANUAL
MJ AEROSPACE THREAD

ISO 5855 / AS8879 — Controlled Root Radius for Fatigue-Critical Applications

Document No.:	KFP-QIM-THD-005
Revision:	F
Effective Date:	2026-03-20
Next Review Date:	2027-03-20
Classification:	Internal Technical Document
Scope:	MJ metric aerospace threads per ISO 5855-1/-2/-3 and SAE AS8879. Mandatory controlled root radius. Sizes M3–M39. For aerospace, defense, and fatigue-critical automotive applications. Does NOT cover standard ISO M threads (see THD-001).

IATF 16949 | ISO 9001 | ISO 14001 Certified Facility

Revision History

Rev.	Date	Description & Triggering Standards	Author	Approved
A	2005-06	Initial release based on ISO 5855-1:1999, ISO 5855-2:1999, ISO 5855-3:1999, SAE AS8879D. Established root radius inspection by optical projector.	Quality Eng.	Quality Dir.
B	2009-03	Added NASM 1312-11 fatigue test reference. Added three-wire method correction for MJ root radius effect on over-wire measurement.	Quality Eng.	Quality Dir.
C	2013-09	Updated fatigue test acceptance criteria. Added CMM thread scanning with root radius extraction algorithm. Enhanced traceability for aerospace lot control.	Quality Eng.	Quality Dir.
D	2016-11	Added optical sorting (limited to presence/damage check; root radius requires optical projector). Updated SPC targets.	Quality Eng.	Quality Dir.
E	2019-08	Cross-referenced UNJ provisions now incorporated into ASME B1.1-2019. Clarified MJ vs UNJ equivalence and differences.	Quality Eng.	Quality Dir.
F	2026-03	Verified ISO 5855 series (1999) remains current. Cross-ref ASME B1.1-2024 for UNJ. Added: CMM root radius scanning parameters, fatigue specimen preparation protocol, post-HT MJ thread verification, short-batch/prototype controls for aerospace first articles.	Quality Eng.	Quality Dir.

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1. Scope and Normative References

1.1 Purpose

MJ threads are modified ISO metric threads with a mandatory controlled root radius that significantly improves fatigue life. They are specified for aerospace fasteners, military hardware, and automotive applications where cyclic loading is the primary failure mode.

1.2 MJ vs Standard M Thread

Feature	Standard M Thread	MJ Thread
Root form	Sharp or tool-wear-rounded (not controlled)	Mandatory controlled radius: R ≥ 0.15011P
Minor diameter tolerance	Standard per ISO 965	Tighter minor dia. tolerance (no sharp root allowed)
Fatigue life	Baseline	40–60% improvement due to stress concentration reduction
Gauge type	Standard ISO 1502 GO/NO-GO	Standard GO/NO-GO + root radius optical inspection
Designation	M10×1.5-6g	MJ10×1.5-4g6g (typically precision class)
Cost	Baseline	Higher (precision tooling, additional inspection)

1.3 Normative References

Standard	Title / Scope
ISO 5855-1:1999	MJ threads — General requirements
ISO 5855-2:1999	MJ threads — Limit dimensions for coarse pitch
ISO 5855-3:1999	MJ threads — Limit dimensions for fine pitch
SAE AS8879 Rev. D	MJ metric screw threads (SAE/aerospace standard)
NASM 1312-11	Fastener test method: fatigue testing of aerospace threaded fasteners
ISO 3506-1:2009	Stainless steel fasteners — Mechanical properties (for SS MJ fasteners)
ISO 965-1:1998	Tolerance principles (baseline for MJ tolerance derivation)
ISO 1502:1996	Gauges and gauging (GO/NO-GO principle applies)
ASME B1.1-2024	Reference for UNJ thread form (inch equivalent of MJ)

2. Thread Geometry

2.1 Root Radius Specification

The defining feature of MJ threads is the controlled root radius on the external thread:

Minimum root radius: $R_{min} = 0.15011 \times P$

Maximum root radius: $R_{max} = 0.18042 \times P$

This radius must be achieved across the full thread length, including the first and last complete threads. Tool wear that produces a radius larger than R_{max} is acceptable only if the minor diameter remains within tolerance.

Table 2.1 — Root Radius Limits for Common MJ Sizes

Size	P	R min	R max	Size	P	R min	R max
MJ5	0.8	0.120	0.144	MJ12	1.75	0.263	0.316
MJ6	1.0	0.150	0.180	MJ14	2.0	0.300	0.361
MJ8	1.25	0.188	0.226	MJ16	2.0	0.300	0.361
MJ10	1.5	0.225	0.271	MJ20	2.5	0.375	0.451

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3. Inspection Methods

3.1 Standard GO/NO-GO Gauging

MJ threads use the same GO/NO-GO principle as standard M threads (per ISO 1502). The GO gauge verifies functional assembly; the NO-GO verifies pitch diameter minimum material limit.

Test	PASS	FAIL	Action	Tag
GO (ext.)	Ring screws on fully	Ring does NOT fully pass	Segregate; check tooling	✓✓ **GREEN**
NO-GO (ext.)	Ring ≤2 turns	Ring >2 turns	Segregate; d_2 undersize	✗ **RED**
GO (int.)	Plug screws in fully	Plug does NOT fully pass	Segregate; check tap	✓✓ **GREEN**
NO-GO (int.)	Plug ≤2 turns	Plug >2 turns	Segregate; D_2 oversize	✗ **RED**

3.2 Root Radius Inspection (CRITICAL)

Root radius is the defining quality characteristic of MJ threads and must be verified separately from GO/NO-GO gauging.

(a) Primary method: Optical profile projector at 50× magnification. Overlay MJ root radius template. Verify R_{min} and R_{max} at 3 positions along thread length.

(b) CMM method: thread profile scan with 120+ points/revolution; software extracts root radius by best-fit arc algorithm. Report R at each scanned revolution.

(c) Frequency: 100% at FAI; then every 25 pcs or 2×/hour during production; 100% if tool change occurs.

> **IMPORTANT:** A thread that passes GO/NO-GO but has an insufficient root radius (<R_{min}) is NON-CONFORMING for MJ. Root radius is a Critical-to-Quality (CTQ) characteristic.

3.3 Fatigue Testing (per NASM 1312-11)

For PPAP and aerospace qualification, fatigue testing validates that the MJ thread root radius achieves the required fatigue life improvement.

(a) Sample size: minimum 15 specimens per lot qualification.

(b) Test method: axial fatigue, R = 0.1 (tension-tension), at specified stress amplitude per NASM 1312-11.

(c) Acceptance: all 15 specimens must survive the specified cycle count without fracture. Fracture origin analysis on any failure.

(d) Frequency: at initial PPAP; then once per year or after any process change affecting thread geometry.

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4. Inspection Equipment

Equipment	Specification	Parameters Measured	Application
Profile projector	50× with MJ root radius overlays per AS8879	Root radius R_{min} / R_{max} verification	FAI + in-process (every 25 pcs)
CMM	Acc. ±0.001 mm; root radius extraction software	d, d_2, d_3, P, flank angle, root radius	FAI, PPAP, audit
GO/NO-GO gauges	Per ISO 1502; MJ-specific minor dia. limits	Functional fit	100% in-process + final
Fatigue tester	Axial fatigue; 10–100 Hz; load cell ±1%	Fatigue life validation	PPAP qualification
Three-wire method	Calibrated wires + MJ root radius correction	Pitch diameter	Borderline verification
AMETEK OES	Multi-element	Material verification	Incoming
Surface tester	Profilometer Ra, Rz	Thread root roughness (fatigue critical)	Per spec; Ra ≤0.8 µm typical

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5. Production & Process Control

MJ threads require precision tooling and tighter process control than standard M threads:

(a) Thread rolling: dies must have the MJ root radius ground into the die profile. Standard M dies produce uncontrolled roots and are NOT acceptable.

(b) CNC single-point: use radius-tipped insert matching R_{min} – R_{max} range. Insert radius must be verified at each tool change.

(c) Post-HT verification: re-inspect root radius after heat treatment. Distortion can alter root form. If threads are rolled after HT (preferred for fatigue), perform full FAI.

(d) Surface finish at root: target Ra ≤0.8 µm. Rougher surfaces reduce fatigue life. Verify with profilometer.

(e) Lot traceability: aerospace MJ fasteners require full lot traceability (material heat number → HT batch → thread rolling setup → inspection record). Each lot must be traceable to individual machine setup.

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Non-Conformance Handling and Disposition

Standard NC Procedure

Step	Action
1. Containment	STOP production. Segregate with RED tag. Quarantine. NCR Form KFP-NCR-001.
2. Scope	Trace to last good inspection. Re-inspect 100% of suspect window.
3. Root cause	8D/5-Why analysis. Common: tool wear, wrong setup, gauge error, material variation.
4. Disposition (MRB)	REWORK / USE-AS-IS (customer concession) / SCRAP.
5. Corrective action	Permanent fix; verify effectiveness over ≥3 production lots.
6. Customer notification	If NC product shipped: 24-hr notice + 8D per IATF 16949 §8.7.1.6.

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Records, Traceability & Documentation

Record	Doc ID	Retention	Storage
Material cert (EN 10204 3.1)	Per lot	15 yr (auto) / 10 yr	QMS + archive
OES report	KFP-MAT-OES-[lot]	= material cert	QMS
FAI report	KFP-FAI-[part]-[date]	Part life + 1 yr	QMS
SPC charts	Auto-generated	Current + 2 yr	SPC database
Gauge log	KFP-GAG-LOG-[line]	Current + 1 yr	QMS
CMM thread report	KFP-CMM-THD-[part]	Part life + 1 yr	QMS + PDF
Final inspection	KFP-FIN-[lot]-[date]	15 yr (auto)	QMS
NCR / 8D	KFP-NCR-[seq]	Part life + 3 yr	QMS
Gauge cal cert	KFP-CAL-[gauge ID]	+ 2 cal cycles	QMS
PPAP package	Per customer	Part life + 1 yr EOL	QMS + portal

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Document Approval

Reviewed and approved by:

Role	Name	Signature	Date
Prepared by:	Quality Engineer		
Reviewed by:	Production Manager		
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END OF DOCUMENT

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