QUALITY INSPECTION TECHNICAL MANUAL
ISO METRIC THREAD (M SERIES)

Production Standards, Inspection Procedures & Acceptance Criteria

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Classification:	Internal Technical Document
Scope:	ISO Metric M-series threads (coarse & fine pitch, M1.6–M100). Does NOT cover non-standard, molded, or special-form threads.

IATF 16949 | ISO 9001 | ISO 14001 Certified Facility

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Revision History

This document has been maintained since 2005. The revision history tracks each update triggered by normative standard revisions, process capability improvements, or customer audit findings.

Rev.	Date	Description of Changes & Standards Triggering Revision	Author	Approved
A	2005-06	Initial release. Established thread inspection procedures based on ISO 68-1:1998, ISO 261:1998, ISO 262:1998, ISO 965-1:1998, ISO 965-2:1998, ISO 965-3:1998, ISO 1502:1996, and ISO 16740:2005. Gauge calibration system aligned with ISO/IEC 17025.	Quality Eng.	Quality Dir.
B	2009-03	Added coated thread tolerance provisions per ISO 965-4:1998 and ISO 965-5:1998 (hot-dip galvanized thread classes 6az, 6AZ, 6AX). Added zinc-nickel and DACROMET post-coating gauge verification requirements. Introduced three-wire method procedure (Section 7).	Quality Eng.	Quality Dir.
C	2013-09	Updated mechanical properties references to ISO 898-1:2013 (4th edition) and ISO 898-2:2012 (3rd edition). Revised property class verification tables. Added torque-angle test requirement for Class 10.9/12.9 automotive fasteners per ISO 16047:2005.	Quality Eng.	Quality Dir.
D	2016-11	Updated thread run-out and undercut specifications to DIN 76-1:2016 (replaced 1983 edition). Revised undercut Type C/D designations per new DIN tables. Added optical sorting machine to inspection equipment matrix; introduced 100% automated final sorting protocol.	Quality Eng.	Quality Dir.
E	2021-08	Incorporated ISO 965-2:1998/Amd.1:2021 (amendment to engagement length tables). Added CMM thread scanning parameters for operator consistency. Enhanced SPC requirements: upgraded target from Cpk ≥1.33 to Cpk ≥1.67 for all thread critical characteristics per customer audit finding (IATF 16949 §9.1.1.1).	Quality Eng.	Quality Dir.
F	2026-03	Major revision. Updated normative references to: ISO 965-2:2024 (4th edition, replaces 1998+Amd.1:2021; new tolerance classes 5H/6h for M1–M1.4; updated engagement lengths for M10×1, M12×1.5, M18×2, M20×2, M22×2); ISO 965-4:2025 (coated external threads, new edition); ISO 965-5:2025 (2nd edition, hot-dip galvanized internal threads, replaces 1998); DIN 76-1:2025 (new edition, replaces 2016). Added: Section 2.2 fine-pitch micro-thread provisions (M1.6–M3); Section 5.2 optical sorting limitations for micro-threads; Section 5.3 CMM scan parameter standardization; Section 6.4 post-heat-treatment re-verification; Section 6.6 pre-shipment packaging audit; Section 9 torque and assembly verification per ISO 16047; Section 10.2 rework restriction matrix for high-strength fasteners; Section 10.3 customer return management. Enhanced coated thread table with Cpk targets, thick coating provisions (>80 µm), and DLC/PVD film guidance. Added short-batch (<500 pcs) enhanced inspection frequency. Added visual identification column to defect table (Appendix B).	Quality Eng.	Quality Dir.

> **Note:** *Document revision follows a letter-increment scheme (A→B→C...). Minor corrections (typos, formatting) do not trigger a new revision; they are recorded in an internal change log maintained by Quality Engineering.*

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1. Scope and Purpose

1.1 Purpose

This technical manual establishes the standardized inspection procedures, acceptance criteria, and quality control methodology for ISO metric threads (M series) produced at the KeyFixPro manufacturing facility. It serves as the definitive reference for all personnel involved in thread production, in-process verification, and final quality inspection.

1.2 Scope of Application

This manual applies to all ISO metric coarse-pitch and fine-pitch threads manufactured by KeyFixPro, covering:

(a) External threads (bolts, screws, studs) produced by CNC turning, cold heading with thread rolling, and thread milling.

(b) Internal threads (nuts, tapped holes) produced by CNC machining, cold forming, and tapping operations.

(c) Thread sizes from M1.6 to M100 in coarse pitch (per ISO 965-2:2024), and fine-pitch series per ISO 262.

(d) Tolerance classes 6g/6H (standard), 4g/4H (precision), 5H/6h (M1–M1.4 per ISO 965-2:2024), and compensated classes for coated threads per ISO 965-4:2025.

(e) Threads on parts subject to surface treatments including zinc electroplate, zinc-nickel, hot-dip galvanizing, DACROMET, and specialty coatings.

1.3 Exclusions

This manual does NOT apply to: non-ISO thread forms (UNC/UNF, Acme, Buttress), molded/cast threads, pipe threads (NPT/BSP/G), or proprietary special-form threads. These are covered by separate manuals within the KFP-QIM series.

1.4 Normative References

Standard	Title / Scope
ISO 68-1:1998	ISO general-purpose screw threads — Basic profile
ISO 261:1998	ISO general-purpose metric screw threads — General plan
ISO 262:1998	ISO general-purpose metric screw threads — Selected sizes
ISO 965-1:1998	Tolerances — Part 1: Principles and basic data
ISO 965-2:2024	Tolerances — Part 2: Limits of sizes (6H/6g M1.6–M100; 5H/6h M1–M1.4). 4th edition, replaces 1998+Amd.1:2021
ISO 965-4:2025	Tolerances — Part 4: Coated external threads. New edition
ISO 965-5:2025	Tolerances — Part 5: Internal threads for hot-dip galvanized externals. 2nd edition, replaces 1998
ISO 1502:1996	Gauges and gauging
ISO 4759-1:2000	Tolerances for fasteners — Part 1
ISO 4753:1999	Thread run-outs and undercuts
DIN 76-1:2025	Thread run-outs and undercuts — Part 1: ISO metric. New edition, replaces 2016
ISO 898-1:2013	Mechanical properties — Bolts/screws (4th edition)
ISO 898-2:2012	Mechanical properties — Nuts (3rd edition)
ISO 16740:2005	General requirements for thread gauges

ISO 16047:2005	Torque/clamp force testing
ISO 2859-1:1999	Sampling procedures — AQL plans

> **IMPORTANT:** ISO 965-2:2024 and ISO 965-5:2025 are newly published. All tolerance look-up tables and gauge selection charts must be updated. Legacy ISO 965-2:1998 tables shall be marked SUPERSEDED in the gauge room.

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2. Thread Geometry Fundamentals (per ISO 68-1)

2.1 Basic Profile Parameters

The ISO metric thread basic profile is defined by a 60° included angle with symmetrical flanks. All dimensional relationships derive from nominal diameter (d) and pitch (P).

Parameter	Formula	Description
Fundamental triangle height (H)	H = 0.86603 × P	Sharp V-thread theoretical triangle height
Pitch diameter (d_2 / D_2)	d_2 = d − 0.6495 × P	Where thread ridge width = groove width
Minor diameter, ext. (d_3)	d_3 = d − 1.2269 × P	Root diameter of external thread
Minor diameter, int. (D_1)	D_1 = d − 1.0825 × P	Root diameter of internal thread
Thread depth (h_3)	h_3 = 5H/8 = 0.5413 × P	Actual depth of external thread
Root radius (R)	R = H/6 = 0.1443 × P	Mandatory root rounding (external)
Crest truncation, ext.	H/8 = 0.1083 × P	Flat at crest of external thread
Crest truncation, int.	H/4 = 0.2165 × P	Flat at crest of internal thread

2.2 Preferred Diameter-Pitch Combinations (ISO 261/262)

Coarse Pitch Series (1st Choice)

Size	P	Size	P	Size	P	Size	P
M3	0.5	M8	1.25	M16	2.0	M30	3.5
M4	0.7	M10	1.5	M20	2.5	M36	4.0
M5	0.8	M12	1.75	M24	3.0	M42	4.5
M6	1.0	M14	2.0	M27	3.0	M48	5.0

2.3 Fine-Pitch Micro-Thread Provisions (M1.6–M3)

For small-diameter fine-pitch threads, the following supplementary requirements apply:

Aspect	Requirement
Tolerance class	ISO 965-2:2024 specifies 5H/6h for M1–M1.4. For M1.6–M3 fine pitch, grade 4 or 5 recommended for high-precision applications.
Measurement uncertainty	At P=0.2 mm, 6g pitch dia. tolerance is ~0.032 mm. Measurement uncertainty must be <10% of tolerance (±0.003 mm) — CMM or optical required, NOT hand gauging.
Gauge availability	GO/NO-GO rings may not be available below M2. Use certified wires (±0.0005 mm) or CMM thread scan with tip R≤0.3 mm.
Blank tolerance	Hold to ±0.005 mm (vs. ±0.02 mm standard). Swiss-type CNC recommended for blank preparation.
Surface finish	Ra ≤1.6 µm on flanks; Ra ≤0.8 µm for critical applications. Roughness represents larger fraction of tolerance zone at small pitch.

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3. Thread Tolerance System (per ISO 965, 2024/2025 Editions)

3.1 Tolerance Classification

Thread Type	Standard Class	Precision Class	Micro (M1–M1.4)
External (bolt)	6g	4g	6h (per 965-2:2024)
Internal (nut)	6H	4H or 5H	5H (per 965-2:2024)

3.2 External Thread 6g Limits (ISO 965-2:2024, Selected Sizes)

Size	P	d max	d min	d_2 max	d_2 min	d_3 max	d_3 min	Td_2
M3	0.5	2.980	2.874	2.655	2.580	2.387	2.301	0.075
M6	1.0	5.974	5.794	5.324	5.212	4.773	4.596	0.112
M8	1.25	7.972	7.760	7.160	7.028	6.466	6.272	0.132
M10	1.5	9.968	9.732	8.994	8.842	8.160	7.938	0.152
M12	1.75	11.966	11.701	10.829	10.659	9.853	9.602	0.170
M16	2.0	15.962	15.682	14.663	14.473	13.546	13.271	0.190
M20	2.5	19.958	19.623	18.334	18.114	16.933	16.624	0.220
M24	3.0	23.952	23.577	21.997	21.747	20.319	19.955	0.250

Note: *Td_2 = pitch diameter tolerance bandwidth. For SPC: Cpk ≥1.67 requires process σ ≤ Td_2 /10.*

3.3 Coated Thread Tolerances (ISO 965-4:2025 / ISO 965-5:2025)

Coating	Thickness	Pre-Coat	Post-Coat	KFP Method	Sample	Cpk / Remark
Zinc electroplate	5–12 µm	6g	6g verify	GO/NO-GO	AQL 0.65	Cpk≥1.33 on d_2 post-plate
Zinc-nickel	8–15 µm	6g	6az (965-4:2025)	CMM+gauge	5/lot CMM	Cpk≥1.67 pre; GO post
Hot-dip galvanize	40–80 µm	6az	6AZ (965-5:2025)	Re-tap; gauge	100% gauge	Verify 6AZ/6AX mating
DACROMET / Zn flake	6–12 µm	6g	6g verify	GO/NO-GO	AQL 0.65	Cpk≥1.33 post-coat
Thick coat >80 µm	80–150 µm	Per eng.	Customer spec	CMM mandatory	100% CMM	Special gauge set req'd
DLC / PVD film	1–5 µm	6g/4g	Same (negligible)	GO/NO-GO	AQL 0.65	<5 µm; std gauge OK

IMPORTANT: ISO 965-5:2025: Internal threads with 6AZ must NOT mate with 965-4 external threads. Severe stripping risk. 6AZ is for centrifuged hot-dip galvanized externals only.

4. Thread Gauge Inspection System (per ISO 1502)

4.1 GO / NO-GO Acceptance Matrix

Test	PASS	FAIL	Action on Fail	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

4.2 Gauge Calibration Management

Requirement	KeyFixPro Practice
Calibration cycle	Every 6 months or 5,000 uses, whichever first
Traceability	Gauge blocks traceable to NIM China / NIST via ISO/IEC 17025 lab
Wear limit	GO gauges monitored per ISO 1502 Table 3; replaced at 80% of NOT-GO approach
Storage	20 ± 2°C, RH < 60%; anti-corrosion cases
ID & tracking	Unique ID; calibration sticker; QMS database status
Out-of-cal action	Quarantine gauge; re-inspect all parts since last good cal; NCR if suspect shipped
Micro-thread gauges	M1.6–M3: dedicated set; cal every 3 months or 2,000 uses (accelerated wear)

5. Thread Inspection Equipment & Capabilities

5.1 Equipment Matrix

Equipment	Specification	Thread Parameters	Application
CMM (3D scan)	Acc. ±0.001 mm; 3 mm/s scan; 120 pts/rev; tip R=0.5 (R=0.3 for M1.6–M5)	d, d_2 , d_3 , P, flank angle, lead error, helix deviation	FAI, PPAP, audit, customer complaint, coated verification
GO/NO-GO gauges	Per ISO 1502; M1.6–M48 coarse + common fine	Functional fit: max/min material condition	100% in-process and final
Optical sorter	100% automated; 0.01 mm/pixel (limited <M3, see 5.2)	Thread presence, major dia., damage, surface defects	100% final sort
3D scanner	<0.01 mm point cloud	Profile vs. CAD; deviation color map	FAI, complex geometry
Profile projector	10×–50×; 300 mm screen	Flank angle, root radius, crest flat	In-process form check
Three-wire method	Wires ±0.001 mm; micrometer 0.001 mm	Pitch diameter (indirect)	Borderline GO/NO-GO; fine pitch
Micrometer / caliper	0.001 mm / 0.01 mm	Major dia., thread length	SPC dimensional checks
Surface tester	Profilometer; Ra, Rz, Rmax	Thread flank roughness	Per customer spec
AMETEK OES	Multi-element optical emission	Alloy composition verification	Incoming: every heat/lot
Torque tester	0.5–500 N·m; ±1%; per ISO 16047	Install/prevail/breakaway/strip torque	PPAP, automotive assembly sim

5.2 Optical Sorting Limitations (M1.6–M3)

(a) Camera resolution insufficient for subtle thread damage at P ≤0.5 mm. False rejection rate 3–5%.

(b) Alternative: dedicated low-speed vision with macro lens 5×–10× at ≤50% conveyor speed.

(c) Lots <5,000 pcs of M1.6–M3: consider 100% manual visual (10×) with GO/NO-GO on every part.

(d) Document inspection method deviation on lot record whenever optical sort is bypassed.

5.3 CMM Thread Scanning Standards

Parameter	Mandatory Setting
Scanning speed	3.0 mm/s max (2.0 mm/s for P ≤ 0.5 mm)
Points per revolution	120 min (180 for fine-pitch P ≤ 1.0 mm)
Axial passes	3 helical revolutions min; 5 for FAI/PPAP
Stylus tip	R=0.5 mm std; R=0.3 mm for M1.6–M5; R=0.25 mm for internal M1.6–M3
Probing force	≤0.1 N
Temperature	20 ± 1°C; part stabilized 2 hr; CTE correction for non-steel
Axis alignment	3-point cylinder fit on unthreaded shank
Output	d, d_2 , d_3 , P, flank angle L/R, lead error/25 mm, helix deviation, roundness at d_2

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6. Thread Inspection Procedures

6.1 Incoming Material Verification

Check	Method	Acceptance
Alloy composition	AMETEK OES; every heat/lot	Per material spec (e.g., ISO 898-1 Table 2)
Material cert	EN 10204 3.1 verification	Cert matches PO; heat traceable
Hardness	Rockwell/Vickers per ISO 6508/6507	Within property class range
Surface condition	Visual; no cracks/laps/seams	Defect-free
Wire/bar diameter	Micrometer 0.001 mm	±0.02 mm (±0.005 mm for M1.6–M3)

6.2 First Article Inspection (FAI)

Mandatory triggers: production start, tooling change, setup adjustment, parameter change, material lot change. Min. 5 consecutive PASS required.

#	Item	Equipment	Criteria	Record
1	**GO gauge**	Thread gauge (ISO 1502)	Passes fully	KFP-FAI-001
2	**NO-GO gauge**	Thread gauge (ISO 1502)	≤2 turns	KFP-FAI-001
3	**Pitch diameter (d_2)**	CMM thread scan	ISO 965-2:2024 limits	CMM printout
4	**Major diameter (d)**	Digital micrometer	ISO 965-2:2024 limits	Dim. record
5	**Minor diameter (d_3)**	CMM / projector	ISO 965-2:2024 limits	CMM / image
6	**Pitch (P)**	CMM lead measurement	±0.005 mm / 25 mm	CMM printout
7	**Flank angle**	Projector 25×	60° ± 1°	Projector capture
8	**Run-out / undercut**	Projector / visual	ISO 4753 / DIN 76-1:2025	Image record
9	**Surface roughness**	Profilometer	Ra ≤3.2 µm (or dwg)	Printout
10	**Thread length**	Caliper / micrometer	Per drawing	Dim. record
11	**Torque (if spec'd)**	Torque tester ISO 16047	Per customer spec	Torque report

6.3 In-Process SPC Inspection

Param	Method	Standard Batch Freq.	Short <500 pcs	SPC	Target
GO/NO-GO	Ring/plug	50 pcs (CNC); 200 (cold head)	100% full	p-chart	0 defects
d_2	CMM / 3-wire	100 pcs or 1×/hr	25 pcs or 4×/hr	X-R	Cpk≥1.67
d (major)	Micrometer	50 pcs or 2×/hr	25 pcs	X-R	Cpk≥1.67
Pitch	CMM	1×/hr	2×/hr	X-R	±0.005/25mm
Form	10× visual	100 pcs	50 pcs	Log	No damage
Tool wear	GO trend	Continuous	Continuous	Trend	80% limit

> **Note:** *Short batch <500 pcs: increased frequency as shown. Lots <100 pcs: 100% GO/NO-GO + 100% major dia. measurement.*

6.4 Post-Heat-Treatment Re-Verification

(a) GO/NO-GO re-check: 100% of lot.

(b) d_2 CMM: 5 pcs/HT batch, or AQL 0.65 Level II for lots >1,000.

(c) Class 10.9/12.9: verify d_2 shift <50% of tolerance band post Q&T. Record pre/post values.

(d) Threads rolled AFTER HT: treat as new operation → full FAI.

6.5 Final Inspection

#	Item	Method	AQL/Criteria	Resp.	Remark
1	**GO/NO-GO post-coat**	Gauge ISO 1502	100% sort + AQL 0.065	QC/Sort	Post-coat mandatory
2	**d_2 verification**	CMM sample	AQL 0.65 Level II	QC	Per ISO 2859-1
3	**Dimensions**	Micrometer, CMM	Per drawing	QC	Full report for PPAP
4	**Surface quality**	10× + optical sort	No damage/burrs	Sort/QC	
5	**Coating thickness**	XRF / cross-section	Per coating spec	Lab	On thread flanks
6	**Assembly function**	Mating nut/bolt	Smooth, no binding	QC	Calibrated mating part
7	**Mech. properties**	Tensile, proof, hardness	Per ISO 898 class	Lab	Destructive; sampling
8	**Torque test**	ISO 16047	Per customer spec	Lab	Automotive/critical

6.6 Pre-Shipment Packaging Audit

(a) After packing: randomly select 10% of boxes (min 1 box/lot).

(b) GO/NO-GO on 5 pcs/box; visual inspect 10 pcs/box for handling damage.

(c) Coated threads: check for coating abrasion, white rust, delamination from part-on-part contact.

(d) Compare with AQL 0.065. Any failure → 100% re-inspect + packaging method review.

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7. Pitch Diameter Measurement — Three-Wire Method

7.1 Formula

$d_2 = M - 3 \times dw + 0.8660 \times P$

M = over-wire measurement; dw = best-size wire = 0.5774 × P; P = pitch.

P	dw	P	dw	P	dw	P	dw	Instrument
0.2	0.115	0.7	0.404	1.5	0.866	3.0	1.732	
0.25	0.144	0.8	0.462	1.75	1.010	3.5	2.021	
0.35	0.202	1.0	0.577	2.0	1.155	4.0	2.309	
0.5	0.289	1.25	0.722	2.5	1.443	4.5	2.598	

7.2 Micro-Thread Wire Requirements (M1.6–M3)

(a) Wires certified to ±0.0005 mm. Standard ±0.001 mm sets introduce >10% uncertainty at P≤0.5 mm.

(b) Bench micrometer with 0.0001 mm resolution, V-groove anvils, constant-pressure thimble ≤5 N.

(c) Preferred: CMM thread scanning for M1.6–M3 (GR&R <10% of tolerance).

8. Thread Production Process Control

8.1 Run-Out and Undercut (ISO 4753 / DIN 76-1:2025)

Feature	Spec (DIN 76-1:2025)	KFP Control
Run-out (ext.)	Max 2P ground; 3P rolled/cut	CNC program; ±0.2 mm; FAI verified
Undercut Type A	To shoulder; per 2025 tables	CNC cycle; CMM/projector at FAI
Undercut Type B	Run-out into shaft; per 2025	Rolling die geometry; visual+gauge
Entry chamfer	45° to minor dia. ±0.1P	CNC chamfer; optical sort presence

8.2 Manufacturing Method Control

Method	Sizes / Materials	Critical Parameters	Quality Characteristics
Rolling (flat die)	M3–M24; steel, SS	Pressure, feed, blank ±0.02 (±0.005 M3), die align	Grain flow; Ra<1.6µm; high Cpk
Rolling (planetary)	M1.6–M12; high-vol	Die spacing, speed, roundness	Consistent; optical sort ready
CNC single-point	All; all materials	Speed, depth/pass, insert, coolant 70–100 bar	Highest accuracy; non-std pitch
CNC thread mill	M6+; hardened	Helix interp., climb/conv., depth	No axial force; burr-free
Tapping (cut)	Int. M3–M30	Speed, lube, peck, tap monitor	Wear monitoring; chip clearing
Tapping (form)	Int. M3–M16; ductile	Speed, lube, hole +0.02 vs cut	No chips; stronger; longer life

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9. Torque and Assembly Verification (per ISO 16047)

Test	Purpose	KFP Application
Installation torque	Tighten to spec without damage/stripping	PPAP for all auto projects; production per customer
Prevailing torque	Run-on torque over locking feature	100% for self-locking; per DV/PV plan
Breakaway torque	Min torque to start unscrewing	Post-vibration; per VDA 235-101 or customer
Torque-angle	Detect yield, stripping, under-tightening	Class 10.9/12.9 powertrain mandatory
Stripping torque	Max torque at thread failure	Destructive; FAI/PPAP 5 pcs min; vs. Alexander formula

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10. Non-Conformance Handling and Disposition

10.1 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. Causes: tool wear, wrong blank dia., thermal drift, wrong gauge, material variation.
4. Disposition (MRB)	REWORK / USE-AS-IS (customer concession) / SCRAP. See 10.2 restrictions.
5. Corrective action	Permanent fix; verify over ≥3 lots.
6. Customer notification	If shipped: 24-hour notice + 8D per IATF 16949 §8.7.1.6.

10.2 No-Rework Conditions (SCRAP Only)

Condition	Reason
d_2 below min material limit	Cannot add material; re-rolling causes double helix
10.9/12.9 thread damage post-HT	Re-cutting disrupts grain flow; fatigue life below ISO 898-1
H_2 embrittlement cracking	Structural compromise; entire plating batch investigate
Galling (stainless)	Cannot restore profile; re-machining below tolerance
Wrong pitch	Requires complete re-threading; all parameters change

10.3 Customer Return Management

(a) Receive into quarantine; assign CCN linked to NCR.

(b) 100% CMM + GO/NO-GO on returned parts.

(c) Cross-ref lot number to production records, SPC, final inspection.

(d) MRB disposition: SCRAP or REWORK (if permitted). No re-ship without MRB + QE sign-off.

(e) 8D report to customer within 10 business days.

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11. Records, Traceability, and 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
Torque test report	KFP-TRQ-[part]-[date]	Part life + 1 yr	QMS
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

12. Appendices

Appendix A — Thread Inspection Decision Flowchart

Color-coded decision flow for posting at inspection stations:

Step	Action / Decision	Type
① Receive part	Verify thread designation: size, pitch, tolerance class, coating.	ACTION
② Check gauge cal.	Sticker current? → Proceed. Expired? → STOP, get calibrated gauge.	ACTION
③ GO gauge	PASS (fully on) → next. | FAIL → RED TAG → NCR.	DECISION
④ NO-GO gauge	PASS (≤2 turns) → next. | FAIL → RED TAG → NCR.	DECISION
⑤ FAI/SPC sample?	YES → CMM or 3-wire d_2 . Record on SPC. | NO → next.	DECISION
⑥ Coated?	YES → Re-gauge post-coat. Fail? → Check thickness. | NO → next.	DECISION
⑦ Heat-treated?	YES → Re-verify GO/NO-GO + d_2 sample. | NO → next.	DECISION
⑧ All PASS	→ Stamp inspection record → GREEN TAG → Release.	PASS

Appendix B — Common Thread Defects

Defect	Causes	Correction	Visual ID for Operator
d_2 oversize (ext.)	Worn dies; blank too large	Monitor wear; verify blank	GO tight/fails; loose in nut
d_2 undersize	Blank small; high pressure	Verify blank; adjust pressure	NO-GO passes (>2 turns)
Torn flanks	Dull insert; poor lube	Replace; verify coolant	Roughness under 10×; scratchy
Drunken thread	Off-center; bent; runout	Chuck TIR<0.01; straighten	Wanders on rotation; GO binds
Incomplete crests	Low pressure; blank small	Adjust; verify size	Flat/missing under 10×
Burrs	Worn tool; bad exit	Replace; spring pass	Sharp edge; catches fingernail
Galling (SS)	Poor lube; tight; rough	Anti-gall treatment; polish	Shiny smear; seizes in gauge
H_2 cracking	No bake; >1050 MPa	190°C/4h within 4 hrs	Hairline cracks at root; 20×

Appendix C — Glossary

Term	Definition
Major dia. (d/D)	Largest thread dia. Ext: crest. Int: root.
Minor dia. (d_3 /D_1)	Smallest. Ext: root. Int: crest.
Pitch dia. (d_2 /D_2)	Ridge width = groove width. Most critical functional dim.
Pitch (P)	Axial distance between adjacent threads (mm).
Lead	Axial advance per revolution. Single-start: lead = pitch.
Flank angle	30° per side (60° included) for ISO metric.
Tolerance grade	Number (3–8) defining magnitude. Lower = tighter.
Tolerance position	Letter (g,h,H) defining zone location.
GO gauge	Full-form at max material. Must fully assemble.
NO-GO gauge	Truncated at min material. Must NOT engage >2 turns.
Cpk	Capability index. ≥1.67 = well-centered within ±5σ.
Coating thickness (µm)	1 µm = 0.001 mm. Compensate per ISO 965-4.

AQL	Acceptable Quality Limit. 0.065 = 65 DPMO.
Stripping torque	Max torque at thread failure.

13. Document Approval

Reviewed and approved by:

Role	Name	Signature	Date
Prepared by:	Quality Engineer		
Reviewed by:	Production Manager		
Approved by:	Quality Director		
Authorized by:	General Manager		

END OF DOCUMENT

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