QUALITY INSPECTION TECHNICAL MANUAL
SELF-TAPPING & SELF-DRILLING THREAD

ST Series, Thread-Forming, Self-Drilling — Inspection & Acceptance

Document No.:	KFP-QIM-THD-006
Revision:	F
Effective Date:	2026-03-20
Next Review Date:	2027-03-20
Classification:	Internal Technical Document
Scope:	Self-tapping screw threads per ISO 1478, self-forming per DIN 7500, self-drilling screws. Covers thread geometry, hardness, drive torque, hydrogen embrittlement. Sizes ST2.2–ST9.5. Does NOT cover standard machine screw threads.

IATF 16949 | ISO 9001 | ISO 14001 Certified Facility

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Revision History

Rev.	Date	Description & Triggering Standards	Author	Approved
A	2005-06	Initial release based on ISO 1478:1999, ISO 2702:1992, ISO 10509:1992. Established hardness and carburization depth inspection.	Quality Eng.	Quality Dir.
B	2009-03	Added DIN 7500 thread-forming screw provisions. Added drive torque / strip torque testing. Added hydrogen embrittlement baking requirements per ISO 4042.	Quality Eng.	Quality Dir.
C	2013-09	Updated ISO 2702 hardness requirements. Added self-drilling screw point geometry inspection (drill point angle, flute geometry). Enhanced salt spray requirements for automotive.	Quality Eng.	Quality Dir.
D	2016-11	Added 100% optical sorting for point presence and thread completeness. Added SPC for carburization depth.	Quality Eng.	Quality Dir.
E	2019-08	Added flow-drill screw (FDS) provisions for automotive BIW applications. Enhanced torque test protocols for multi-material stack joints.	Quality Eng.	Quality Dir.
F	2026-03	Verified all normative refs current. Added: CMM point geometry scanning, post-plating H_2 embrittlement test protocol (incremental loading per ISO 15330), clamp force verification for FDS, short-batch controls, packaging audit for pointed fasteners.	Quality Eng.	Quality Dir.

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1. Scope and Normative References

1.1 Scope

This manual covers self-tapping, self-forming, and self-drilling screw threads that create their own mating thread in the receiving material. Three categories:

(a) Self-tapping (thread-cutting): ST series per ISO 1478. Chip-producing; hardened point cuts thread into material.

(b) Self-forming (thread-forming): per DIN 7500. No chips; displaces material to form thread. Tri-lobular and other non-circular cross-sections.

(c) Self-drilling: integrated drill point eliminates pre-drilling. Combines drilling and tapping in one operation.

1.2 Normative References

Standard	Title / Scope
ISO 1478:1999	Tapping screw thread — Dimensions (ST series)
ISO 1479:1983	Hexagon head tapping screws — GO/NO-GO gauging
ISO 2702:1992	Heat-treated steel tapping screws — Mechanical properties (hardness, carburization)
ISO 10509:1992	Hexagon flange head tapping screws
DIN 7500:2012	Thread-forming screws — Metric thread (tri-lobular and other forms)
ISO 4042:2022	Fasteners — Electroplated coatings (including H_2 embrittlement baking requirements)
ISO 15330:1999	Fasteners — Preloading test for detection of hydrogen embrittlement (incremental loading)
ISO 16047:2005	Torque/clamp force testing

2. Thread Geometry (per ISO 1478)

2.1 ST Series Dimensions

ST (Self-Tapping) thread sizes are designated by nominal diameter and do not follow ISO metric pitch conventions. The thread form has a wider pitch and steeper helix angle than machine screw threads to enable self-tapping action.

ST Size	d (mm)	Pitch	d_2	ST Size	d (mm)	Pitch	d_2
ST2.2	2.2	0.8	1.73	ST4.8	4.8	1.6	3.84
ST2.9	2.9	1.1	2.24	ST5.5	5.5	1.8	4.44
ST3.5	3.5	1.3	2.76	ST6.3	6.3	1.8	5.17
ST4.2	4.2	1.4	3.35	ST9.5	9.5	2.0	8.08

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3. Critical Inspection Parameters

3.1 Hardness and Carburization (per ISO 2702)

Parameter	Requirement	KFP Test Method
Surface hardness	450–600 HV0.3 (case-hardened)	Vickers micro-hardness on thread flank cross-section
Core hardness	280–400 HV10 (must remain ductile)	Vickers on longitudinal cross-section at core
Carburization depth	0.05–0.15 mm (depending on screw diameter)	Metallographic cross-section + micro-hardness traverse
Decarburization	Not permitted on thread surface	Metallographic examination; no ferrite layer at surface
Hydrogen embrittlement	No cracking after baking (190°C / 4h within 4 hrs of plating)	ISO 15330 incremental loading test; or 48-hr sustained load test

> **IMPORTANT:** Self-tapping screws are case-hardened high-carbon steel. They are highly susceptible to hydrogen embrittlement after electroplating. Baking at 190°C for 4 hours within 4 hours of plating is MANDATORY per ISO 4042.

3.2 Drive Torque and Strip Torque Testing

(a) Drive torque (T^d): torque required to drive screw into test plate. Must not exceed specified maximum (indicates thread is too tight or material too hard).

(b) Strip torque (T_s): torque at which threads strip in test plate. Must exceed minimum (indicates adequate thread engagement strength).

(c) Acceptance: T_s / T^d ratio ≥ 2.5 (minimum safety factor against stripping during assembly).

(d) Test frequency: 5 pcs per production lot; 100% if lot size <100 pcs.

3.3 Point Geometry (Self-Drilling)

(a) Drill point angle: typically 130°–140° for steel-to-steel; verified by profile projector.

(b) Flute geometry: must clear chips effectively. Visual inspection under 10× for flute completeness.

(c) Drill capacity test: screw must drill through specified test plate thickness within maximum drive time or rotation count.

4. Inspection Equipment

Equipment	Specification	Parameters Measured	Application
GO/NO-GO gauges	Per ISO 1479 for ST series	Functional thread fit	100% in-process + final
Vickers hardness	HV0.3 (surface) and HV10 (core)	Case/core hardness	Every HT batch; 5 pcs
Metallographic lab	Polishing + etching + microscope 200×–500×	Carburization depth, decarburization	Every HT batch; 2 pcs destructive
Torque tester	0.1–50 N·m; ±1%	Drive torque, strip torque, T_s /T^d ratio	5 pcs / lot
Profile projector	10×–50×	Drill point angle, thread form, flute geometry	FAI + setup
Optical sorter	High-speed camera	Thread presence, point presence, length, damage	100% final
CMM	Acc. ±0.001 mm	Thread dimensions, point geometry	FAI, PPAP
H_2 embrittlement test	Sustained load fixture per ISO 15330	H_2 cracking detection	Every plating batch
AMETEK OES	Multi-element	Material verification	Incoming

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5. Inspection Procedures

(a) Incoming: per THD-001 Section 6.1. Wire must be verified for carbon content (carburization potential) and surface quality.

(b) FAI: thread dimensions (GO/NO-GO + CMM) + hardness (surface/core) + carburization depth + drive/strip torque + point geometry.

(c) In-process: GO/NO-GO every 200 pcs; hardness every HT batch; torque every 500 pcs or 1×/shift.

(d) Post-plating: H_2 embrittlement test (ISO 15330) on every plating batch. Baking verification (time/temperature log). GO/NO-GO re-check after plating.

(e) Final: 100% optical sort + AQL 0.065 gauge check + packaging audit per THD-001.

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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.

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

Document Approval

Reviewed and approved by:

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

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