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J933

MECHANICAL AND QUALITY REQUIREMENTS FOR TAPPING SCREWS—SAE J933

SAE Recommended Practice

Report of Iron and Steel Technical Committee approved July 1965.

Scope—This SAE Recommended Practice covers the mechanical and quality requirements for steel tapping screws used in automotive and related industries. It does not apply to corrosion resistant (stainless) steel screws. It is intended to cover only tapping screws of the type and dimensions covered in SAE J478. Requirements for other types of tapping screws are not covered in this recommended practice.

The primary objective of the specification is to insure that screws form or cut mating threads in materials of construction into which they are normally driven, without deforming their own thread and without breaking during assembly or service.

NOTE: Certain limitations on basic material and manufacturing processes have been incorporated because the size and configuration of the parts under consideration make them vulnerable to relatively small variations in chemistry, heat treatment, etc., and because experience has shown that in processing, it is difficult to keep these variables consistently "in balance." Until improved performance tests are developed these limitations will supplement the "performance" features of the specification.

Material and Processing Requirements—Screws shall be made from cold heading quality, killed steel wire. Chemical composition (percent by weight) shall conform to the following:

	Check Analysis[a]	Ladle Analysis[a]
Carbon	0.13–0.25	0.15–0.23
Manganese	0.64–1.16	0.70–1.10

[a]Ladle analyses are shown for informational purposes. Check analyses are mandatory and refer to individual determinations on uncarburized or core portion of screws.

SAE 1024 also permitted for tapping screw stems, and long screws, as follows:

	Check Analysis[a]	Ladle Analysis[a]
Carbon	0.17–0.27	0.19–0.25
Manganese	1.29–1.71	1.35–1.65

[a]Ladle analyses are shown for informational purposes. Check analyses are mandatory and refer to individual determinations on uncarburized or core portion of screws.

SAE 1016 also permitted for Number 4 and smaller size screws, as follows:

	Check Analysis[a]	Ladle Analysis[a]
Carbon	0.11–0.20	0.13–0.18
Manganese	0.57–0.93	0.60–0.90

[a]Ladle analyses are shown for informational purposes. Check analyses are mandatory and refer to individual determinations on uncarburized or core portion of screws.

Core Hardness after Tempering—Shall be Rockwell C28-38[1], as determined at midradius of a transverse section through the screw taken at a distance sufficiently behind the point of the screw to be through the full minor diameter.

Surface Hardness after Tempering—Shall be Rockwell 15N 83.0 (C45) minimum, as determined by a microhardness instrument at "root of thread profile," as exposed by removal of enough material to form a "flat" along length of screw. For routine quality control purposes, it is common practice to measure surface hardness on end, shank, or head.

Case Depth—Shall conform to the following, as measured at thread flank midpoint between crest and root:

Size	Thickness, in.
No. 4 thru 6	0.002–0.007
No. 8 thru 12	0.004–0.009
1/4 and larger	0.006–0.011

Microstructure—Shall show no band of free ferrite between case and core, as determined by metallographic examination.

Heat Treatment—Shall be in carbonitriding or gas carburizing system. Cyaniding systems may be approved by specific purchaser when it is shown that a continuous flow (no batch) quenching process is employed which consistently produces uniform case and core.

Tempering Temperature—650 F minimum shall be used.

Quenching Media—Screws smaller than ¼ in. may be quenched in water or oil at the option of the producer. Screws ¼ in. and larger shall be water quenched, but oil quenching may be used by agreement between purchaser and supplier.

Performance Requirements—

Drive Test[2]—Sample screws (coated or uncoated, as received) shall, without deforming their own thread, form a mating thread in test plate described below until a thread of full diameter is completely through the test plate.

In cases where screws are plated subsequent to delivery to the purchaser (or where plating of screws is otherwise under the control of the purchaser) the screw producer is not responsible for failures due to plating. In such cases, additional screws from the same lot shall be stripped of plating, baked, lubricated with machine oil, and retested in the plain finish condition.

The test plate shall be made of low carbon cold rolled steel, having hardness of Rockwell B60-80 or equivalent, and thickness as specified in Table 1. Test holes shall be drilled or punched and redrilled, or reamed, to ±0.001 in. of normal diameters specified in Table 1 for type and size screw being tested.

Torsional Strength Test—Shank of sample screw (coated, or uncoated, as received) shall be clamped in a mating, split, blind-hole die (Fig. 1) or other means, such that the clamped portion of the thread is not damaged and at least two full threads project above the clamping device and at least two full form threads exclusive of point and end slot are held within the clamping device. (A blind hole may be used in place of the clamping device, providing the hole depth is such to insure that breakage will occur beyond the point, or the full length of the flute(s) or end slot.) By means of a suitably calibrated torque measuring device, apply torque to the screw until failure occurs. The torque required to cause failure shall equal or exceed the minimum value shown in Table 2 for the type and size of screw being tested.

Ductility Test—Not required at this time; under development.

Testing Requirements—

1. The requirements of this specification shall be met in continuous mass production for stock, and the producer shall make sample inspections to insure that the product is controlled within the specified limits. Additional tests of individual shipments are not ordinarily contemplated. Individual heats of steel are not identified in the finished product, and testing on a heat basis is not feasible.

When specified on purchase order or engineering drawing, the manufacturer shall furnish a report certified to be the latest set of test results for the following tests for each stock size in each shipment: Core Hardness, Drive Test, and Torsional Strength Test.

Chemical and metallurgical tests (material analysis, surface hardness, case depth, metallographic examination of cross section) are not inspected frequently during normal processing, and consequently, such

[1] Hardness shall not exceed maximum shown and preferably should be no higher than C36 to insure against failure in assembly and service.

[2] This test does not apply to Type BF, BG, and BT screws.