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Surface Hardness Testing with Files

SAE Recommended Practice
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Submitted for Recognition as an American National Standard

The Engineering Society For Advancing Mobility Land Sea Air and Space®
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MATERIALS PRACTICE

SAE J864

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SURFACE HARDNESS TESTING WITH FILES

1. APPLICATION:

This procedure describes the technique of using a file for testing the surface hardness of miscellaneous iron and steel parts as designated by engineering specifications. In presenting this procedure, it is recognized that it is subjective and that it must be used with considerable judgment on the part of the operator. File hardness tests may be used when case depth is too shallow for conventional indentation hardness methods, to detect the presence of a soft surface condition on hardened or case-hardened parts, or to check the hardness of sintered parts that may not respond predictably to indentation hardness methods. The method is useful in production control.

2. SCOPE:

Hardness testing with files consists essentially of cutting or abrading the surface of metal parts, and approximating the hardness by the feel, or extent to which, the file bites into the surface. The term file hard means that the surface hardness of the parts tested is such that a new file of proven hardness will not cut the surface of the material being tested.

3. APPARATUS REQUIRED:

3.1 Standard Files: Hand files meeting the following requirements:

150 or 200 mm (6 or 8 in) pillar
No. 1 Swiss double cut
26 cuts per cm (66 per in)
Hardness of File: 65-68 HRC designated No. 65
61-63 HRC designated No. 62
57-59 HRC designated No. 58
54-56 HRC designated No. 55
49-51 HRC designated No. 50

Chemical Composition:		
	Carbon	1.20-1.40%
	Manganese	0.20-0.40%
	Phosphorus	0.40 max
	Sulfur	0.05 max
	Silicon	0.10-0.20%

3.2 Standard Prover: Standard steel or iron test pieces, 50 mm (2 in) diameter and approximately 6 mm (1/4 in) thick, hardened and tempered to the hardness of the lower limit of each standard file range, are required for testing the standard files.

The prover shall be filed with a discarded test file to remove any hard or soft skin that will interfere with the accuracy of the test. Similar provers hardened to ranges below and above the medians can be used to prove the file will cut below and not above the designated file hardness.

CHART OF FILES AND PROVERS

File No.	Standard Prover Hardness	Prover Cutting Hardness	Prover Noncutting Hardness
Untempered 65	65 HRC	63 HRC	67 HRC
Tempered[a] 62	61 HRC	60 HRC	64 HRC
58	57 HRC	56 HRC	60 HRC
55	54 HRC	53 HRC	57 HRC
50	49 HRC	48 HRC	52 HRC

[a]Using tempered files below 65 HRC is less accurate and, therefore, more judgment on the part of the operator must be exercised as the hardness of the file decreases.

Testing of files is performed by passing the test file across the 6 mm (1/4 in) thick face of the prover.

A 6 mm (1/4 in) prover is specified because at the higher hardnesses, the surface area contacted affects the cutting area considerably. Narrow areas can be cut more readily than wide areas due to the concentration of pressure that may be obtained.

3.3 Standard Test Pieces: Standard test pieces (of the same contour, steel or iron composition and heat treatment) varying in hardness by small increments, with which the parts being inspected can be compared, are recommended. In the case of steels, each family of SAE steels, namely, 10XX, 20XX, 30XX, and the like should be used. They can be heat treated to compare with the operation, such as carburized, quench and temper or carbonitrided, quenched and temper.

These pieces will enable the operator to learn, with fair accuracy, the feel of the file as it cuts, or does not cut, in relation to the Rockwell hardness.

4. SURFACE CONDITION:

In testing high surface hardnesses with a file, experience has shown that surface condition is important; very smoothly ground surfaces cannot be touched with a file as readily as surfaces that have been filed. Sometimes a testing file will cut a prover of a certain steel at, for example, 64 HRC, yet when the file is applied to a smoothly ground part made of the same steel and at the same hardness, the part feels harder. It is important when comparisons are made that the surface smoothness of the parts being tested be the same as the standard test piece. The standard test pieces can be made in a series of microfinish of 0.5, 1.5, 3.2 and 5 µm (20, 60, 125, and 200 microinches).

On surfaces with a microfinish, the direction of the test filing across or parallel with the finish direction affects results. When filing, the direction of the file in relation to the microfinish should always be the same as the standard test piece.

5. TESTING HARDNESS:

5.1 Check file against standard prover.

5.2 Apply the file to the surface of the part being tested at such an angle that only a few teeth will engage the surface at once. Use slow, firm strokes in an effort to feel the manner in which the file cuts or does not cut. To prolong the life of the file, use as short a stroke as possible.

Note: To standardize pressure, attach specimen to a balance scale platform and measure the file effort against specimen in kilograms (pounds). Application should be between 4.5 and 5.5 kg (10 and 12 lb).

5.3 Compare the parts with a standard test piece with a known hardness range. This will assist in determining whether the part falls within the range specified by the engineering specifications. File hardness should not replace conventional methods where penetrators will not break through surface hardened areas.

Note: During the testing of a batch of parts, the files must not be allowed to become so dull as to cause difficulty in discriminating between parts within specification and those below specification. This can be prevented by frequent checking against the standard part or prover.

5.4 The hardness should be specified according to the Rockwell reading of the file as to the surface requirements of an iron or steel part. The designation should be "file hard - 65" for 65 HRC surface; "file hard - 62" for 62 HRC and so on.

6. SOURCES OF TEST FILES:

6.1 Simonds Cutting Tools, Newcomerstown, Ohio. Available through distributors in boxes of 10 files per hardness level.

6.2 Nicholson Files, Raleigh, North Carolina. Available in minimum quantities of 600.

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

Not applicable.

APPLICATION:

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