SAE International™ SURFACE VEHICLE STANDARD

J442	REV. MAY2006
Issued 1952-01	
Revised 2006-05	
Superseding J442 DEC2001	

Test Strip, Holder, and Gage for Shot Peening

RATIONALE

NOTE: (T) for technical changes and (E) for editorial changes.

1. (T) Figure 1 – Test Strip Specifications

    a. Recommendation: Replace "Edge Type: Number 1 round" with "Edge Type: Number 1 (does not apply to ends of strip)

    b. Rationale: edge type number one includes several variations, all of which are acceptable for the purpose of the test strip. Although the "round" edge may have nicer appearance the use of square edge number one or other variants does not affect the performance of the test strip. Relaxing this requirement will give the strip producers more flexibility in procuring raw material and will not be detrimental to the performance of the test strip.

2. (T) Figure 1 – Test Strip Specifications

    a. Recommend deleting tempering temperature of 371 °C (700 °F)

    b. Rationale: This is not the correct tempering temperature for the desired hardness range. Since the objective is to produce strips of certain hardness it should be left to the discretion of the producer to select the tempering temperature, which could be influenced by carbon content or as-quenched hardness.

3. (E) Figure 1 – Test Strip Specifications

    a. Recommend deleting "Flatness: Measured as the reading on the Almen gage for each strip type is as follows:" and replacing with "Pre-bow:" the arc height as measured by the Almen gage prior to peening. The maximum allowed pre-bow for each type of strip is as follows:"

    b. Rationale: Pre-bow is the arc height measured on the Almen gage prior to peening. The Almen gage does not measure flatness per se.

4. (T) Figure 2 Assembled Test Strip and Holder

    a. Recommendation: add sentence "One or two additional holes may be used to facilitate mounting the holder to a fixture. The hole(s) may be threaded and shall not extend into the strip contact surface of the holder."

    b. Rationale: Several commercially available holders already accept the practice of mounting the holder by use of extra threaded holes. This provides a convenient method of attaching the holder to a fixture. The addition of such holes that do not degrade the performance of the holder should be allowed.

5. (T) 6.4 Zero Block (Add)

   a. Recommendation: “A zero block, approximately the size of an Almen strip in length and width or large enough to contact the Almen gage 4-balls and indicator tip, with a minimum thickness of 5 mm shall be used to set the zero datum of the Almen gage. Flatness of the zero blocks shall be within ±.001 mm. Lapping the surface to achieve flatness is recommended.

   b. Rationale: It is common industry practice to use a zero block similar to these dimensions but there has never been dimension or tolerance criteria established in J442. However, SAE J443 Section 5 states: “General – Prior to use, the zero position of the gage shall be checked with a flat calibration block (see SAE J442), and, if necessary, adjusted.” Therefore, to be consistent with J443 we need to add the zero block to J442. The flatness tolerance of ±0.001 mm can be easily met and inspected by standard commercial practices.

6. (T) Figure 3 Almen Gage

   a. Recommendation: add a tolerance for distance between back post -0.5 to +2.0 mm.

   b. Rationale: the absolute distance between the posts (i.e. the 20 mm span from centerline) is not critical. Only the distance of the edges of the posts to the centers of the ball centerlines (1.69/1.49 mm) is critical. Some older gages did not maintain the 20 mm ± 0.5 mm tolerance but they, nevertheless, still functioned appropriately. Spacing the back posts 20 mm with a tolerance of +2.0 mm and -0.5 mm has no influence on the accuracy of the strip reading. It would seem to be unnecessarily rigorous to disqualify a gage for this reason.

7. (T) Section 6.3

   a. Recommendation: Replace “Any visual signs of wear…” with “Visual signs of wear or flat spots on the ball greater than 1.0 mm (.039 inch).“ Posts should be inspected for grooves that may interfere with proper seating of the test strip on the 4-ball platform and, if necessary, replaced.

   b. Rationale: Virtually any use of the gage will produce “visual signs of wear” thereby rendering the gage useless. The present accept/reject criteria are entirely subjective leaving interpretation to auditors and inspectors. Inspection for flat spot of 1.0 mm can be easily accomplished using 5x to 10x magnification and a simple scale or calipers. This is the procedure used by several aerospace companies.

1. SCOPE

This SAE Standard defines requirements for equipment/supplies to be used in measuring shot peening intensity. Guidelines for the use of these articles (test strip, holding fixture, and gage) are also included.

2. REFERENCES

2.1 Related Publications

The following publications are provided for information purposes only and are not a required part of this specification. The latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J443 Procedures for Using Standard Shot Peening Test Strip

SAE AMS-S-13165 Shot Peening of Metal Parts

2.1.2 ASTM Publication

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E 18 Standard Test Method for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

3. OUTLINE OF METHOD OF CONTROL

The control of a peening machine operation is primarily a matter of the control of the properties of a stream of shot in relation to the work being peened. The basis of measurement of these properties is as follows:

If a flat piece of steel (the test strip) is clamped to a solid block (the test strip holder) and then exposed to a stream of shot, it will be curved upon removal from the block. The curvature is due to residual compressive stresses induced by the shot impacts, causing the peened face to be convex. The curvature serves as a means of measuring the effect of the shot stream. The degree of the curvature depends upon the properties of the shot stream, the properties and mounting of the test strip, and the exposure condition.

3.1 Properties

3.1.1 Shot Stream

The properties of the shot stream are: shot material (includes chemical and physical characteristics), size, shape, velocity, directional consistency, and shot flow rate.

3.1.2 Test Strip

The properties of the test strip are: material (includes chemical and physical properties), hardness, physical dimensions, and the extent of any internal stresses. The properties of the test strip mounting are flatness, rigidity, and the location and force of the holding means.

3.1.3 Exposure

The properties of exposure to the blast stream are length of time, angle of impact, and the degree of uniformity and consistency of the geometric relationship between the shot stream and test strip.

3.2 Standards

Based on these principles, the SAE has adopted the following standards: test strips, holding block, and gage. Specifications for these parts, the method of use, and a standard designation are presented herein.

4. SPECIFICATIONS OF INTENSITY MEASURING EQUIPMENT

4.1 Test Strips and Holding Fixture

Standard test strips, N, A, and C are shown in Figure 1 and test strip holder is shown in Figure 2. The approximate relationships between readings of test strips N, A, and C (for conditions of identical blast and exposure) are as follows:

C strip reading x 3.5 = A strip reading
A strip reading x 3.0 = N strip reading

4.2 Gage

The gage (Almen gage) for determining the curvature of the test strip must incorporate the elements shown in Figure 3. Curvature of the test strip is determined by a measurement of the height of the combined longitudinal and transverse arc across standard chords. This arc height is obtained by measuring the displacement of a central point on the nonpeened surface from the plane of four balls forming the corners of a particular rectangle. To use this gage, the test strip is located so that the indicator spindle bears against the center of the NONPEENED surface, one long edge of the strip bearing against the two back stops. The test strip is then centered by placing the ends even with the edges of the base, or by resting the ends against built-in end stop(s).

5. DESIGNATION STANDARD OF INTENSITY MEASUREMENT

5.1 Primary Standard

The standard designation of intensity measurement includes the gage reading and the test strip used. It may be explained by the example shown in Figure 4.

5.2 Transition Standard

Gages utilizing the inch-pound system (English units) may be encountered during the period of transition to SI. The designation of intensity measurement in this temporary alternate is explained in the example shown in Figure 5.

6. MAINTENANCE, CALIBRATION AND USE

6.1 Test Strips

After removal from the test strip holder, test strips should not be replaced, re-used, or shot peened for any additional time.

6.2 Holding Fixture

The test strip contact area of the holding fixture shall be checked for flatness on a periodic basis. Flatness of the test strip contact area shall not exceed 0.1 mm. In addition to a dimensional check for flatness, holding fixtures shall be checked visually for the following characteristics:

a. Burrs or raised material that can be caused by damage or excessive peening (particularly on the holding fixture end faces).

b. Particles of shot or beads that could become trapped under the test strip during installation.

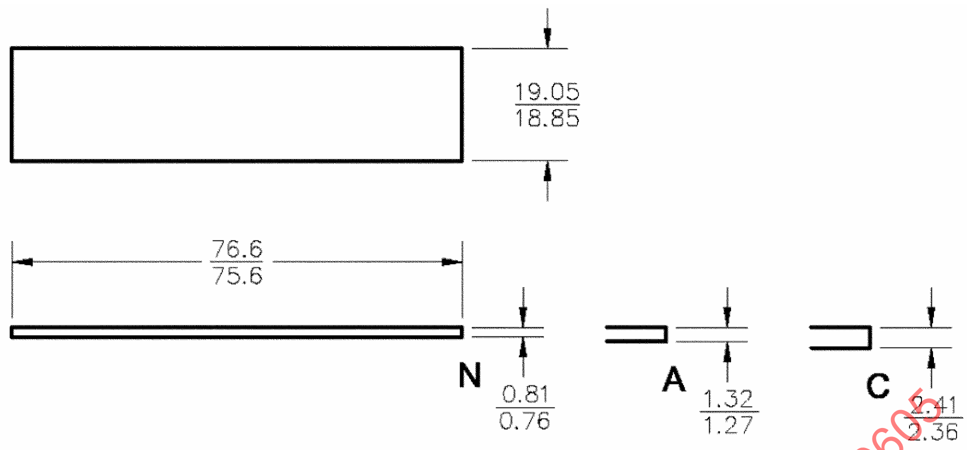
c. Damage to threads that may prevent one or more screws from adequately holding the test strip in place.

6.3 Gage

Locating balls and indicator tip shall be checked periodically for wear. Any visual signs of wear or flat spots on the ball greater than 1.0 mm (.039 inch) shall be cause for repair of the gage such that new round surfaces are in contact with the test strip. Posts should be inspected for grooves that may interfere with proper seating of the test strip on the 4-ball platform and, if necessary, replaced. The indicator shall be calibrated periodically over the range used for measuring test strips. The calibration tolerance for the indicator shall not exceed 0.005 mm. The use of calibration blocks, either flat, curved, or equipped with steps, is recommended.

6.4 Zero Block

A zero block, approximately the size of an Almen strip in length and width or large enough to contact the Almen gage 4-balls and indicator tip, with a minimum thickness of 5 mm shall be used to set the zero datum of the Almen gage. Flatness of the zero blocks shall be within ±.001 mm. Lapping the surface to achieve flatness is recommended.



Pre-bow: The arc height as measured by the Almen gage prior to peening. The maximum allowed pre-bow for each strip is as follows:

N - .025
A - .025
C - .038

Material: SAE 1070 cold rolled spring steel.

Edge Type: Number 1 (does not apply to ends of strip)

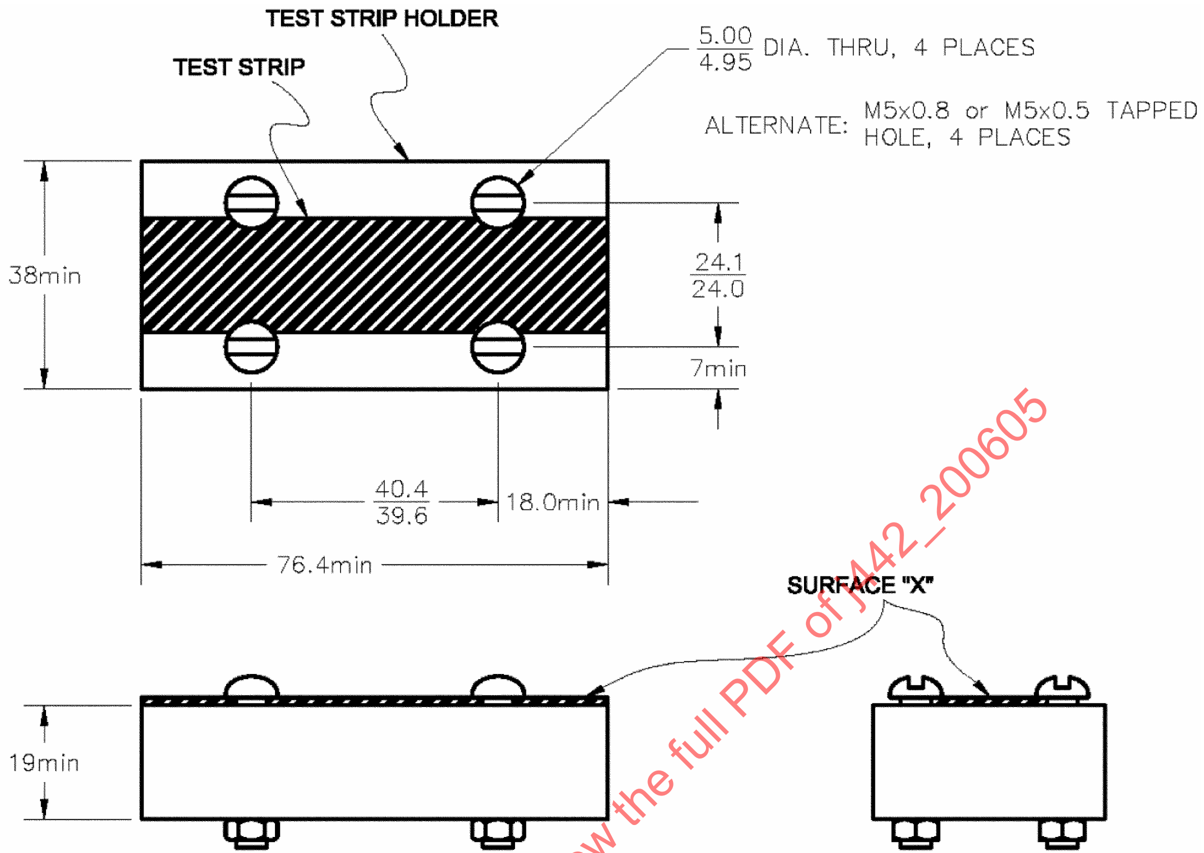
Finish: Plain tempered, all burrs removed.

Heat Treatment: All strips must me uniformly hardened and tempered to produce tempered martensite having a hardness, as measured on the surface, of HRC 44-50 (HRA 72.5-76.0 for the "N" strip).

Surface Carbon: Strips shall be free from alteration of surface carbon to the degree that any difference in average hardness between the surface and subsurface shall not exceed two points as measured on the Rockwell 30-N scale. The average of at least four readings in each region should be used to make the comparison. Any such determinations must be made on strips which have not been shot peened, and will preclude other use of strip to be tested. Surface hardness readings that are less than subsurface readings indicate evidence of decarburization. Surface readings which are higher than corresponding subsurface values indicate carburization.

Example: If the average surface hardness is 62.5 on the Rockwell 30-N scale and, after careful grinding, a region below the surface is found to be 64.0 on the Rockwell 30-N scale - the strip is acceptable. If the subsurface reading had been 65.0 on the Rockwell 30-N scale, the difference (2.5 points) being over two points constitutes grounds for rejection.

FIGURE 1 - TEST STRIP SPECIFICATIONS



Recommended Material for test Strip Holder - Any alloy or carbon steel, hardened to 57 HRC for a minimum depth of 0.7mm. Alternate materials and thicknesses may be used when their wear and deformation characteristics do not adversely affect the performance of the test strip.

One or two additional holes may be added to facilitate mounting the holder to a fixture. The hole(s) may be threaded and shall not extend into the strip contact surface of the holder.

Use M5 socket head or pan head screws and hex or square nuts.

Alternate: Use screws only in tapped holes.

FIGURE 2 - ASSEMBLED TEST STRIP AND HOLDER