



AEROSPACE MATERIAL SPECIFICATION

AMS2590™**REV. C**Issued 2010-12
Revised 2022-04

Superseding AMS2590B

Rotary Flap Peening of Metal Parts

RATIONALE

AMS2590C results from a Five-Year Review and update of this specification with the deletion of test strips being specified by the purchaser as these are stated in SAE J442 (3.1.3), addition of instructions regarding test strip holder and magnets to ensure there is no movement of the test strip (3.1.4), addition of new calibration requirement for measuring equipment (3.1.5), addition of general requirement that parts be peened to the extent specified (3.3), rewording of intensity to include CEO approval for alternate methods (3.4.1), addition of CEO approval of alternate arc height conversion methods (3.4.2), reworded used flap examination requirements for flap replacement to percent of missing shot (3.4.7), and added calibration requirement for rpm controller (3.5.1.1).

1. SCOPE

1.1 Purpose

This specification covers procedures and requirements for peening of metal parts with portable, bonded-shot, rotary flap assemblies in accordance with AS2592. The principles of rotary flap peening are similar to conventional shot peening, except conversion of arc height values using the magnetic test strip holder is required for intensity determination.

1.2 Application

This process is normally used for peening or local repeening of blemished areas, straightening and reshaping of parts, for plating adhesion testing, and for cosmetic surface restoration of peened parts, but usage is not restricted to these applications. Use of rotary flap peening requires customer approval when used to replace manual or automated shot peening. Conformance with AMS2430 is required to the extent specified herein.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2430 Shot Peening

AS2592 Flap Assemblies, Rotary Flap Peening

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AS7766	Terms Used in Aerospace Metals Specifications
SAE J442	Test Strip, Holder, and Gage for Shot Peening
SAE J443	Procedures for Using Standard Shot Peening Almen Test Strip
SAE J2277	Shot Peening Coverage Determination

3. TECHNICAL REQUIREMENTS

3.1 Equipment

3.1.1 Rotary Tools

Pneumatic or electrically powered rotary tools shall be used which can accommodate mandrels described in AS2592. The rotary tool shall be capable of operating at speeds that will produce the required intensity. Actual operational speed of the rotary tool is dependent on the desired intensity and is established in 3.4.1. Once the operational speed is established the rotary tool shall be capable of maintaining a constant speed within ± 100 revolutions per minute (rpm) while the flap is in contact with a work piece or test strip.

3.1.2 Flaps and Mandrels

Flaps and mandrels shall conform to AS2592.

3.1.3 Test Strips and Gage

Test strips and gage shall conform to SAE J442.

3.1.4 Test Strip Holder

A magnetic strip holder conforming to Figure 1 shall be used. It shall consist of a nonmagnetic material block with three permanent magnets loosely recessed into the top side for the purpose of positioning a test strip. The holder and magnets shall be constructed to ensure that the magnets maintain contact with the test strip as it arcs. The design should minimize test strip movement during peening. The magnets and their fasteners shall be adjusted to allow the strip to lie flat on the holder. The magnets shall be allowed to move while maintaining contact with the test strip while peening. A backstop shall be located as shown in Figure 1 to prevent the test strip from moving out of position. An optional backstop may be added at the opposite end of the test strip to provide a level approach surface to the test strip. This will prevent the shot on the flaps from hitting the exposed end of the test strip which may dislodge them from the flap. The form of the back stops are not restricted as long as they function as outlined above. The height of the backstops may vary to suit the use of the different Almen test strip thicknesses. The bottom surface of the holder shall be faced with non-skid material.

3.1.5 Calibration

The processor's equipment used for measuring and controlling the shot peening process such as gages, tachometers, stroboscopes, or closed loop rpm controllers shall be calibrated as recommended by the manufacturer. Calibration shall be made against instruments whose calibration is traceable to National Institute of Standards and Technology or other industry standards, unless waived by the cognizant engineering organization.

3.2 Part Preparation

3.2.1 Customer Responsibility

The customer shall provide all parts to the supplier meeting the following criteria: areas of parts to be peened shall be within dimensional requirements and surface finish requirements, all fillets shall be properly formed, all burrs shall be removed, all heat treatments shall be completed, all non-destructive testing shall be completed, all edges and corners to be peened shall be radiused or chamfered, and all coatings removed.

3.2.2 Cleaning and Stripping

Unless otherwise specified, all areas shall be cleaned by methods that are not physically or chemically damaging. Procedures for stripping coatings shall be as specified or approved by the cognizant engineering organization. All parts shall be clean and dry prior to peening.

3.2.3 Masking

Areas of the part where peening is prohibited shall be suitably masked or protected if within area of possible flap contact.

3.3 Peening

Parts shall be peened to the extent specified.

3.4 Properties

3.4.1 Intensity

3.4.1.1 The intensity shall be determined in conjunction with process setup and prior to peening parts unless alternative control/verification methods such as a specific rotation speed (rpm) is specified by the cognizant engineering organization.

3.4.1.2 Intensity shall be determined from a saturation curve in accordance with 3.4.3. The saturation curve developed intensity is limited to each individual operator and specific equipment, flapper size, and test strip type

3.4.1.3 When approved by the cognizant engineering organization, alternative methods for intensity measurement may be employed. It is the responsibility of the peening processor to substantiate the use of alternative methods for approval.

3.4.2 Arc Height Conversion

Strip arc height measurements obtained using the magnetic strip holder shall be converted to the values equivalent to those that would be obtained using the SAE J442 strip holder using Figures 2A, 2B, 2C, or 2D. The figures have conversion graphs and tables for A and N strips. Only the converted arc heights shall be used for data points on saturation curves. Any conversions for C test strips shall be provided by the cognizant engineering organization prior to use. Alternative arc height conversion methods may be used as permitted by the cognizant engineering organization

3.4.3 Intensity Determination Methods

Intensity shall be determined by either of the two methods below. The SAE J443 10% rule method is preferred, but the test strip coverage method is permitted.

3.4.3.1 SAE J443 10% Rule Method

Intensity is determined from a saturation curve with the converted arc height at the first point whose time when doubled produces an arc height increase of 10% per SAE J443.

3.4.3.2 Test Strip Coverage Method

For this method, a saturation curve is developed by plotting converted arc heights and strip coverage versus time. Intensity is determined as the converted arc height of the saturation curve test strip at the time when it reaches full coverage as determined by the methods in SAE J2277.

3.4.4 Number of Test Strips

Regardless of which intensity method is used, only one test strip is required for the entire saturation curve.

3.4.5 Gage and Test Strip Procedure

The single test strip shall be used to zero the gage which shall conform to SAE J442. In using the gage, the central portion of the side of the test strip that will not be peened shall be placed against the indicator stem of the gage. The test strip shall be attached to the magnetic strip holder so that the surface of the strip which contacted the gage shall be facing the magnets. The end of the test strip shall contact the backstop as shown in Figure 1.

3.4.6 New Flap Preparation

New flaps shall be examined to confirm that no resin coating exists over the shot prior to use. If a coating exists, the flap shall be conditioned by operation against an abrasive paper or a hard surface to remove the coating. The resin coating, if not removed, will cushion the impacts against the test strip and prevent peening.

3.4.7 Used Flap Examination

Used flaps shall be examined for shot loss. The loss of shot will affect coverage time, but not intensity. Flaps shall be replaced when 20% of shots are missing.

3.4.8 Test Strip Coverage Area

Peening of the extreme ends of test strips is not necessary. However, uniform coverage of at least the central 2 inches of length is essential to ensure accurate arc height measurement across the Almen gage 1.25 inch support ball distance. See 8.3.

3.4.9 Intensity Verification

The intensity shall be verified by peening one test strip for the intensity time "T" of the saturation curve accepted at the initial intensity determination using the initial parameters, operator, and equipment. Intensity verification is acceptable if the converted test strip arc height is within ± 0.0015 inch (± 0.038 mm) of the original intensity arc height and within the required intensity range.

3.5 Process Preparation

3.5.1 Establishment of Tool rpm

To achieve the required peening intensity, the tool rpm may be estimated by referring to Figure 3. This shall be a first estimate that shall be confirmed or adjusted by generation of a saturation curve.

3.5.1.1 Verification of Tool rpm

All rpm measurements shall be verified with a tachometer, stroboscope except when a calibrated closed loop rpm controller is used. Tool rpm shall be verified at the actual worksite in the same conditions/configuration as the part being peened. Tool rpm shall be verified prior to the creation of the saturation curve, verification of the intensity, and application of the peening process to any single work area. Elapsed time between tool rpm verification shall not exceed 60 minutes.

3.5.2 Peening of Holes (1/2 to 1-1/4 inch diameter)

The required tool rpm shall be established by first determining the rpm required to achieve the required intensity on a flat surface and then multiplying by the hole size factors shown in Figure 4. Flap width may be trimmed to accommodate hole depth.

3.5.2.1 Holes 1/2 to 3/4 Inch Diameter

Flap size of 9/16 x 1 inch shall be used.

3.5.2.2 Holes 3/4 to 1-1/4 Inch Diameter

Flap size of 9/16 x 1-1/4 inch shall be used.

3.5.3 Flap Operation

The flap shall be moved over the surface being peened with longitudinal sweeps and transverse oscillation, i.e., circular, or elliptical motion to provide uniform surface coverage. Flap deflection (standoff distance from the bottom of mandrel to part surface) should be between 0.05 inch and 0.150 inch as determined by the operator so as to be comfortable, sustainable, and effective. No attempt shall be made to force uniformity of the parameters chosen by the operators as they are operator-specific. Proper flap deflection will be found to be the easiest position to maintain by a given individual operator.

3.6 Coverage

Parts shall be peened to the extent specified on the engineering drawing. Coverage shall be verified by visual inspection in accordance with SAE J2277 at a magnification of 5 to 30X. Visual examination shall show uniform and complete overlapping of impressions. Holes shall be inspected with a suitable optical instrument.

3.6.1 Peening Time

The area to be peened shall be peened in increments of time and visually inspected for coverage until full coverage is achieved. Coverage time is a function of part material hardness. Soft parts will receive larger peening dents and will cover faster than harder parts. For coverage requirements greater than 100%, the time to reach full coverage of a peened area shall be determined and then multiplied by the greater coverage percentage for total peening time.

3.7 Post-Peening Operations

Post-peening operations, including temperature exposure, surface finish improvement, and protection from corrosion, shall be in accordance with AMS2430.

3.8 Qualification of Peening Operators

3.8.1 Qualification Tests

Qualification testing of peening operators shall consist of proving capability of peening technique, intensity determination, and part peening procedures. The operator shall demonstrate proper rotary tool motion and consistent flap deflection (stand-off distance) techniques to fulfill the requirements of 3.8.1.1 through 3.8.1.3.

3.8.1.1 Intensity Determination

The operator shall demonstrate proper test strip and gage handling including gage zeroing or prebow compensation and intensity determination as outlined in 3.4.3.

3.8.1.2 Intensity Verification

A saturation curve shall be considered satisfactory when the operator reproduces an intensity value (intensity verification) from a saturation or saturation coverage curve that the operator has previously accomplished within ± 0.0015 inch (± 0.038 mm) and within the required intensity range. In case of failure to reproduce the intensity verification within that limit, the operator shall be allowed only one retest. Test failure may require retraining or result in disqualification and must requalify again.

3.8.1.3 Part Peening Qualification

The peening operator shall satisfactorilypeen a sample part representative of those commonly peened to demonstrate coverage.

3.8.1.4 Operator Qualification Record

The peening facility is responsible for retaining a written record of the peening operator's qualification testing for each intensity and specific equipment, flapper size, and test strip type. Retention period shall be 5 years, minimum.

3.8.1.5 Status Maintenance

Qualified status of operators shall be maintained by either maintaining record of continued satisfactory workmanship or by successful re-qualification testing (3.8.1) not greater than every 6 months. Periodic re-qualification will not be required for operators when records indicate a satisfactory level is being maintained in production peening.

3.9 Tolerances

Tolerances shall be in accordance with AMS2430.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Process Control and Inspection

The processor shall supply all samples for processor's tests and shall be responsible for performance of all required tests. When parts are to be tested, the parts shall be supplied by purchaser. The cognizant engineering organization reserves the right to sample and to perform any testing deemed necessary to ensure that processing conforms to the specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Intensity (3.4.1) and coverage (3.6) are acceptance tests.

4.3 Sampling and Testing

4.3.1 Intensity Tests

Intensity determination or verification shall be performed prior to peening of part(s), when flap is changed, or when the intensity/rpm requirement changes unless waived by the cognizant engineering organization.

4.3.2 Coverage

All parts shall be visually inspected for coverage.

4.4 Approval

The process shall be approved by the cognizant engineering organization before parts are peened. Requirements for approval shall include submission of a process plan describing equipment, a sample saturation curve, and descriptions of typical areas to be peened. If the processor makes a significant change to the process from that which was used for process approval, all preproduction tests shall be performed, and the results submitted to the cognizant engineering organization for process reapproval unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, could affect the properties or performance of the parts.

4.5 Reports

The processor shall furnish a report stating that the parts have been processed and tested in accordance with the specified requirements and that they conform to the acceptance test requirements. This report shall be kept on file for the period of the contract. Applicable information shall also be kept on file necessary for qualification of operators. Each report shall include the purchase order number, AMS2590C, quantity, and the following:

- a. Part number and name
- b. Area peened
- c. Date peened
- d. Type of strip used

- e. Rotary tool used, flap size, and speed (rpm)
- f. Specified range and actual peening intensity verification
- g. Confirmation that specified coverage of part was achieved
- h. Confirmation that the magnetic test strip holder has been used

5. PREPARATION FOR DELIVERY

5.1 Packaging and Packing

The preservation, packaging, and packing methods for peened parts on articles employed by a supplier shall be such as to preclude any physical damage during handling and shipment.

6. ACKNOWLEDGMENT

The processor shall mention AMS2590 and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS

Parts which do not conform to this specification or to modifications authorized by cognizant engineering organization will be subject to rejection with subsequent disposition determined by the purchaser.

8. NOTES

8.1 Revision Indicator

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

8.2 Equipment Recommendations

To help maintain a constant rpm, a pneumatic powered rotary tool should have a dedicated supply line regulated to maintain constant pressure with a flow controller at the tool for speed control. If a rotary tool (pneumatic or electric) cannot maintain a constant rpm as outlined in 3.1.1, a tool with closed-loop rpm control may be required.

8.3 Peening at Low Intensity

Peening only the central 2 inches offers a significant time saving when generating saturation curves at low intensity.

8.4 Terms used in AMS are defined in AS7766.

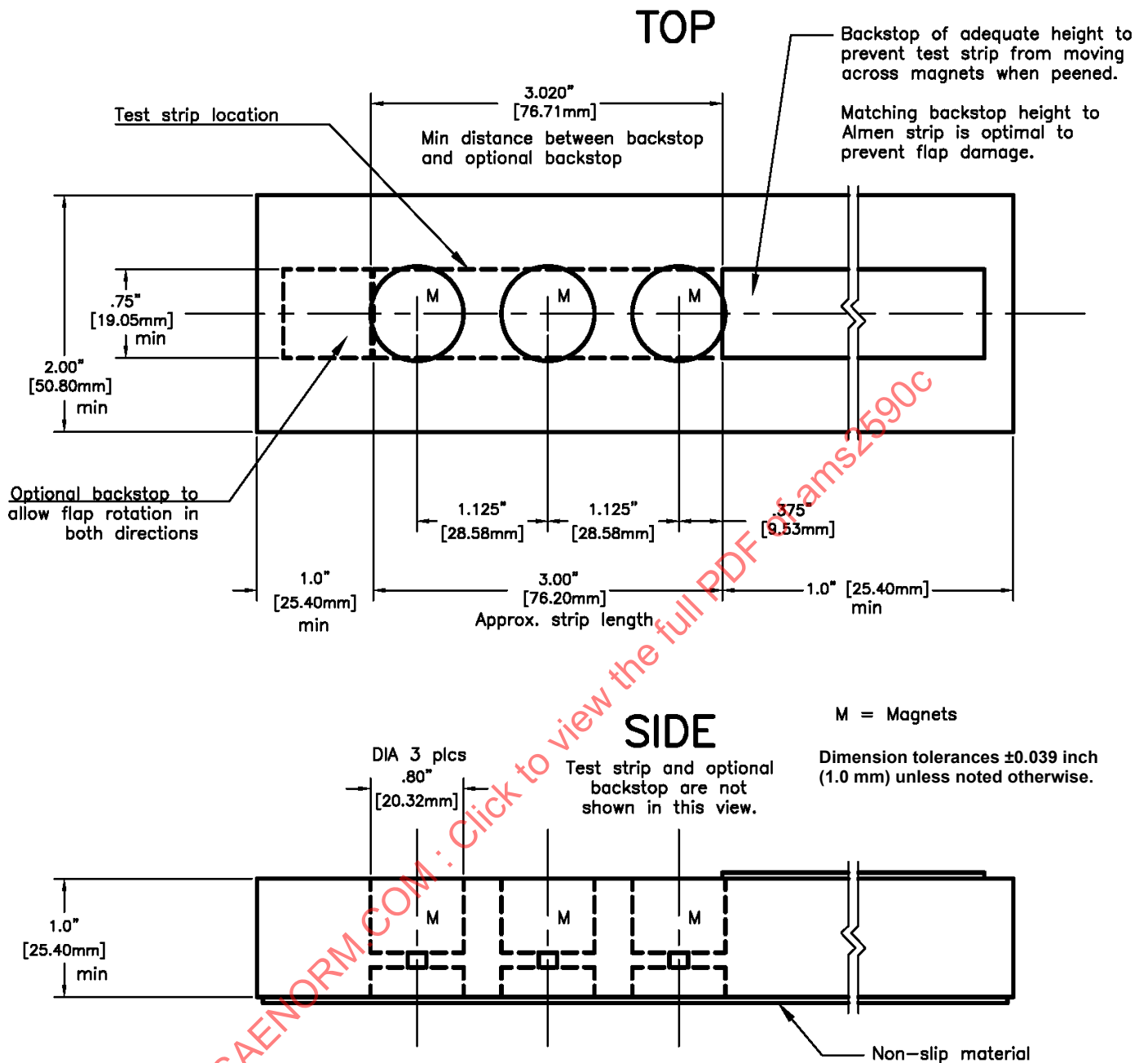


Figure 1 - Magnetic strip holder

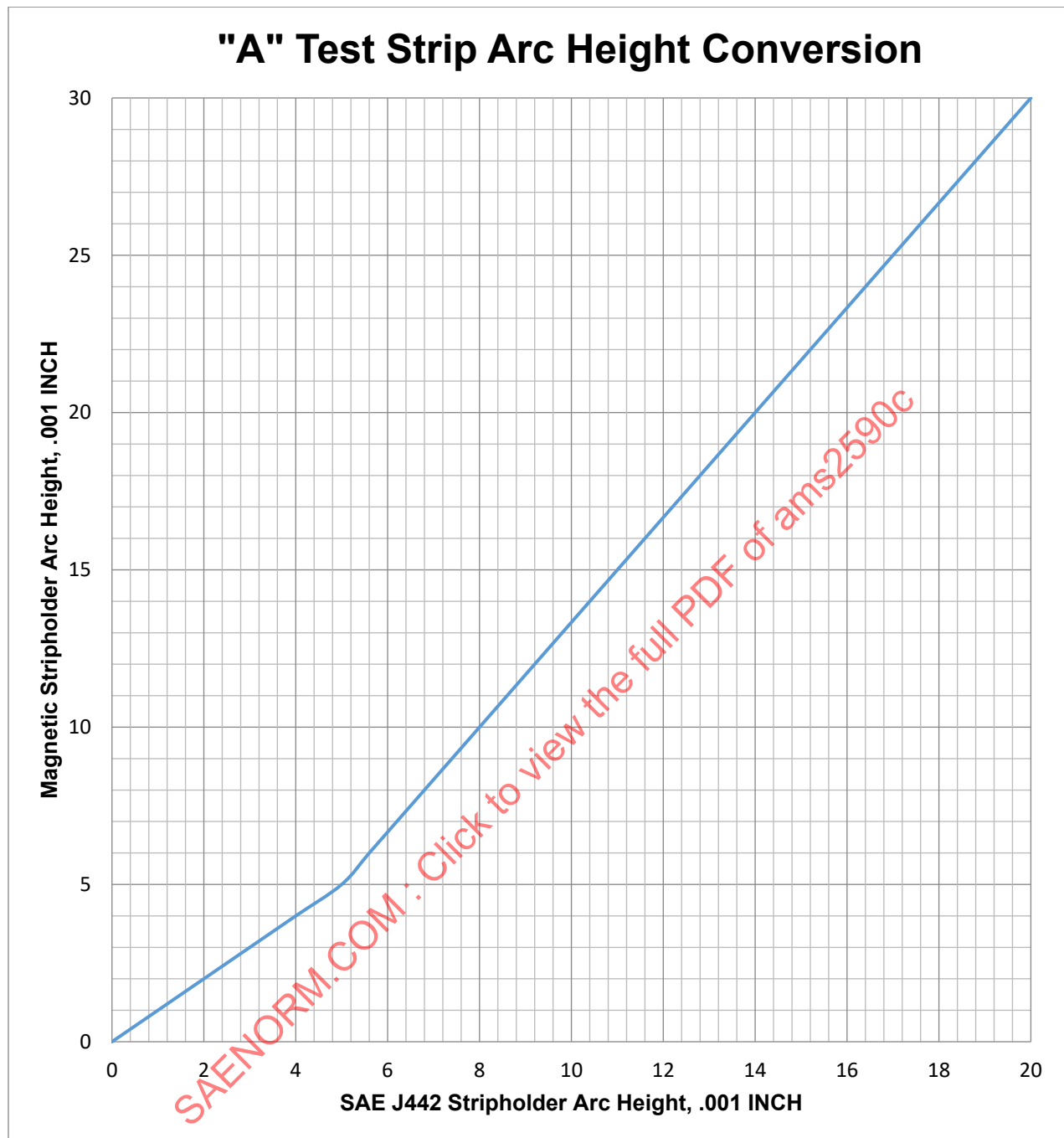


Figure 2A - "A" test strip magnetic to SAE J442 strip holder arc height conversion graph

<i>Magnetic Arc Hgt</i>	SAE J442 Arc Hgt	<i>Magnetic Arc Hgt</i>	SAE J442 Arc Hgt	<i>Magnetic Arc Hgt</i>	SAE J442 Arc Hgt	<i>Magnetic Arc Hgt</i>	SAE J442 Arc Hgt
5.0	5.0	9.0	7.4	13.0	9.8	17.0	12.2
5.1	5.1	9.1	7.5	13.1	9.9	17.1	12.3
5.2	5.1	9.2	7.5	13.2	9.9	17.2	12.3
5.3	5.2	9.3	7.6	13.3	10.0	17.3	12.4
5.4	5.2	9.4	7.6	13.4	10.0	17.4	12.4
5.5	5.3	9.5	7.7	13.5	10.1	17.5	12.5
5.6	5.4	9.6	7.8	13.6	10.2	17.6	12.6
5.7	5.4	9.7	7.8	13.7	10.2	17.7	12.6
5.8	5.5	9.8	7.9	13.8	10.3	17.8	12.7
5.9	5.6	9.9	7.9	13.9	10.3	17.9	12.7
6.0	5.6	10.0	8.0	14.0	10.4	18.0	12.8
6.1	5.7	10.1	8.1	14.1	10.5	18.1	12.9
6.2	5.7	10.2	8.1	14.2	10.5	18.2	12.9
6.3	5.8	10.3	8.2	14.3	10.6	18.3	13.0
6.4	5.8	10.4	8.2	14.4	10.6	18.4	13.0
6.5	5.9	10.5	8.3	14.5	10.7	18.5	13.1
6.6	6.0	10.6	8.4	14.6	10.8	18.6	13.2
6.7	6.0	10.7	8.4	14.7	10.8	18.7	13.2
6.8	6.1	10.8	8.5	14.8	10.9	18.8	13.3
6.9	6.2	10.9	8.5	14.9	10.9	18.9	13.3
7.0	6.2	11.0	8.6	15.0	11.0	19.0	13.4
7.1	6.3	11.1	8.7	15.1	11.1	19.1	13.5
7.2	6.3	11.2	8.7	15.2	11.1	19.2	13.5
7.3	6.4	11.3	8.8	15.3	11.2	19.3	13.6
7.4	6.4	11.4	8.8	15.4	11.2	19.4	13.6
7.5	6.5	11.5	8.9	15.5	11.3	19.5	13.7
7.6	6.6	11.6	9.0	15.6	11.4	19.6	13.8
7.7	6.6	11.7	9.0	15.7	11.4	19.7	13.8
7.8	6.7	11.8	9.1	15.8	11.5	19.8	13.9
7.9	6.7	11.9	9.1	15.9	11.5	19.9	13.9
8.0	6.8	12.0	9.2	16.0	11.6	20.0	14.0
8.1	6.9	12.1	9.3	16.1	11.7	20.1	14.1
8.2	6.9	12.2	9.3	16.2	11.7	20.2	14.1
8.3	7.0	12.3	9.4	16.3	11.8	20.3	14.2
8.4	7.0	12.4	9.4	16.4	11.8	20.4	14.2
8.5	7.1	12.5	9.5	16.5	11.9	20.5	14.3
8.6	7.2	12.6	9.6	16.6	12.0	20.6	14.4
8.7	7.2	12.7	9.6	16.7	12.0	20.7	14.4
8.8	7.3	12.8	9.7	16.8	12.1	20.8	14.5
8.9	7.3	12.9	9.7	16.9	12.1	20.9	14.5

**Figure 2B - “A” test strip arc height magnetic to SAE J442 strip holder
conversion chart, 0.001 inch**

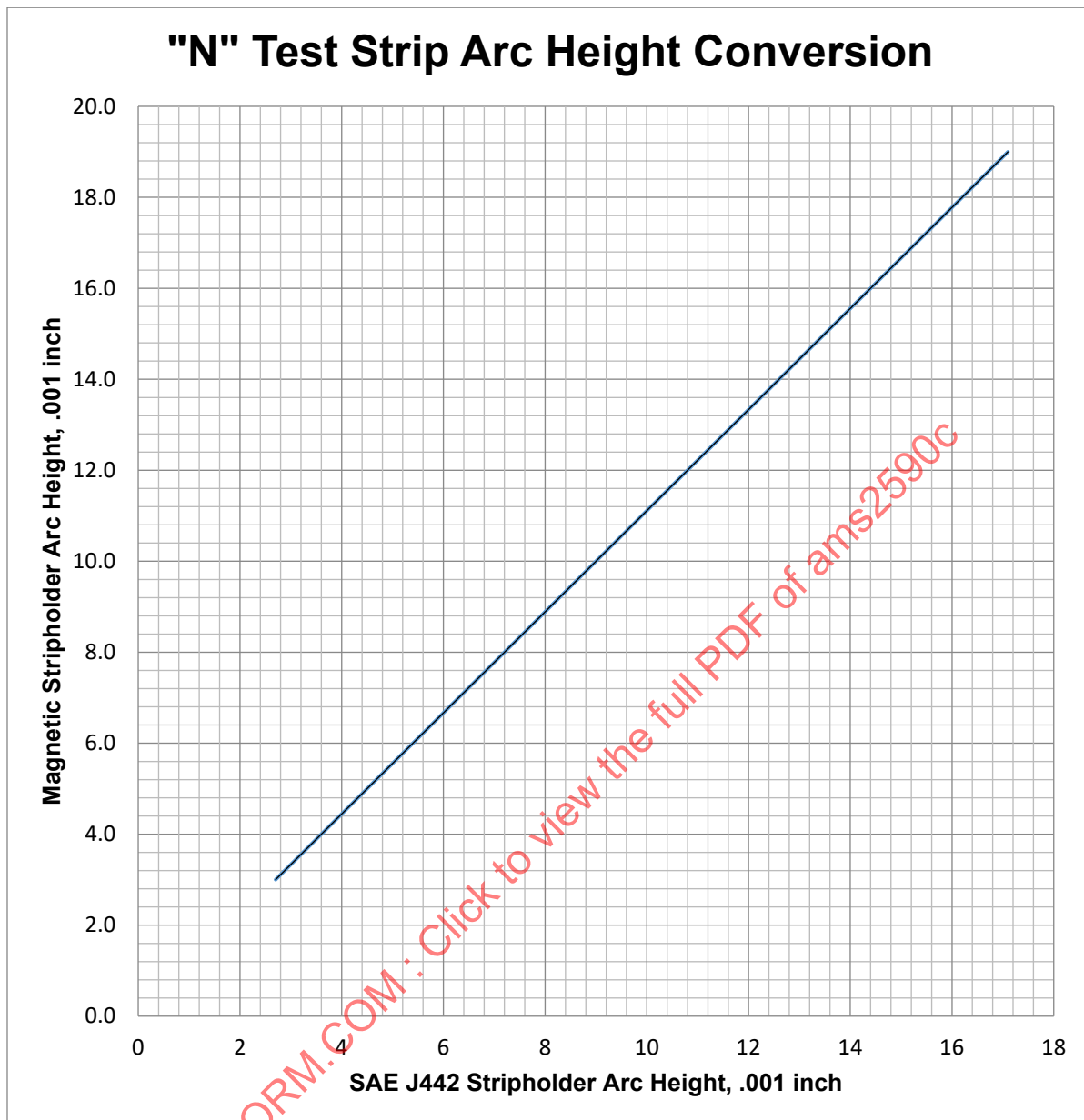


Figure 2C - "N" arc height magnetic to SAE J442 strip holder conversion graph