74006

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18 October 1974

MILITARY SPECIFICATION

PEENING OF METALS

This specification has been approved by the Naval Air Systems Command, Department of the Navy.

1. SCOPE

1.1 Scope. This specification covers procedures and requirements for dry peening the surfaces of metals by impingement of metallic shot or glass beads for the purpose of increasing the fatigue strength and resistance to stress corrosion cracking by inducing residual compressive stresses in specified surfaces.

2. APPLICABLE DOCUMENTS

2.1 The following documents of issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

Specifications

Federal

RR-S-366	Sieves, Standard for Testing Purposes

Military

MIL-S-851	Steel Grit, Shot and Cut Wire Shot; and Iron Grit and Shot-Blast Cleaning and Peening
MIL-S-5002	Surface Treatments and Coatings for Metal Surfaces of Weapons Systems
MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-I-6866	Inspection, Penetrant, Method of
MIL-I-6868	Inspection Process, Magnetic Particles
MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-G-9954	Glass Beads: For Cleaning and Peening
MIL-S-13165	Shot Peening of Metal Parts

MFFP

(Copies of specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Peening equipment. The peening equipment shall provide means for a controlled rate propelling of dry metallic shot by air pressure or centrifugal force or of dry glass beads by air pressure against the work. The peening machine shall be equipped with suitable nozzles, deflectors or baffles to direct the peening medium against the part where desired and to prevent peening of areas not to be peened. The machine shall be so designed that the part to be peened is securely fastened. Mechanical means shall be provided to move uniformly either the part or the shot stream in either translation or rotation or both during peening. This movement shall be powered by a speed device such as a synchronous motor, induction motor, differential pressure cylinder or other controlled speed devices capable of automatically replenishing and maintaining an adequate quantity of shot at all times for maximum effectiveness and consistent reproduction of required peening intensities. Series motors and single acting cylinder activating mechanism are prohibited. All work shall be moved mechanically unless manual movement is permitted by the procuring activity in the contact or order.

3.2 Peening material. Peening material shall be either metallic shot or glass beads. Metallic shot shall conform to MIL-S-851 as hardened cast steel (Type I), cast iron (Type II) or stainless steel cut wire (Type III). Glass beads shall be essentially solid spheres hard tempered, chemically pure crown glass and shall conform to MIL-G-9954, except for sieve analysis. Peening materials shall be capable of producing the required peening intensity without excessive fracturing or deformation of the particles.

3.2.1 Size. Unless otherwise specified, the as-received particle size distribution of the metallic shot shall conform to the applicable tables of MIL-S-851 for both cast shot and for cut stainless steel wire. Glass beads shall range in size from 0.0024 to 0.0661 inch (0.061 to 1.68 mm) in diameter. Unless otherwise specified, the particle size disbribution of the as-received glass beads shall conform to MIL-G-9954 or to Table I, as selected by the peening contractor. Unless otherwise specified, the nominal size of the peening media charged into a machine shall be at the option of the supplier.

3.2.2 Uniformity. The shot or beads shall be free from sharp edges and broken pieces. Cast shot shall be spherical in shape and form and shall be free as practical from elongated, angular particles. Cut wire shot shall be free from shear cracks and laps, shall not contain seams or burrs, and shall be preused or otherwise conditioned to remove sharp edges before being used for peening, and shall be spherically formed. When visually examined the maximum number of deformed cast shot shall not exceed the values stated in Table II.

Table II - Uniformity of Cast Shot

Shot Peening Number (See MIL-S-851, Table III)	Number of Acceptable Deformed Shot - Maximum	Area-Square Inch	Shot Peening Number (See MIL-S-851, Table III)	Number of Acceptable Deformed Shot - Maximum	Area-Square Inch
930 and 780	5	1	320, 280, 230,	20	1/2
660 and 550	12	1	190 and 170		
460	15	1	130	30	1/4
390	20	1	110 and 70	40	1/4

3.2.3 Shot maintenance. Equipment shall have a separator for continuous removal of broken or defect shot material during peening. Metallic shot shall be maintained in the equipment and shall not require replacement until more than 20 percent by weight shall pass through the sieve size specified in Table III for the shot peening number used. When so specified, glass bead peening equipment used on unpeened surfaces shall be so arranged that no beads are returned. Glass beads used for peening over steel shot peened surfaces shall be replaced every two hours of operation.

3.2.4 Usability. Ferrous and non-ferrous metals shall not be peened interchangeably with the same peening medium in the same machine. Neither glass beads nor metal shot used on ferrous parts shall later be used on non-ferrous parts.

Table III - Uniformity of Steel Shot in the Equipment

Shot Peening Number (See MIL-S-851, Tables III and IV)		20% - Maximum Amount Passing Through Sieve 1/		Shot Peening Number (See MIL-S-851, Tables III and IV)		20% - Maximum Amount Passing Through Sieve 1/	
Cast shot	Cut steel wire	Sieve number	Nominal opening - inch	Cast shot	Cut steel wire	Sieve number	Nominal opening - inch
930	-	16	0.0469	280	CW 28	45	0.0139
780	-	18	0.0394	230	CW 23	50	0.0117
660	CW 62	20	0.0331	190	-	60	0.0098
550	CW 54	25	0.0278	170	CW 20	70	0.0083
460	CW 47	30	0.0234	130	-	100	0.0059
390	CW 41	35	0.0197	110	-	120	0.0049
330	CW 35	40	0.0165	70	-	170	0.0035
-	CW 32	40	0.0165				

1/ Sieves shall be as specified in RR-S-366

3.3 Preparation procedures.

3.3.1 Dimensions and conditions of parts. Areas of parts to be peened shall be within dimensional requirements and surface finish requirements before peening. Except as otherwise permitted (see 3.5.1), all heat treatments to meet requirements for mechanical properties, all machining, grinding and required polishing of areas shall be completed before peening. All fillets shall be properly formed, all burrs shall be removed and all sharp edges and corners to be peened shall be provided with sufficient radii to result in complete coverage without any distortion prior to peening.

3.3.2 Cleaning and stripping. Unless otherwise specified, all areas shall be cleaned in accordance with MIL-S-5002. Procedures for stripping coatings shall be as specified or approved in the contract or order (see 6.11).

3.3.3 Masking. Areas of the part or work piece which are designated in the contract or applicable drawing as having critical surface finishes that must be free from peening shall be suitably masked or otherwise handled to protect such surfaces. When it is impractical to mask areas designated to be free from peening marks, sufficient stock may be provided in these areas for subsequent removal of affected material for compliance with dimensional requirements of the applicable drawings. Masking shall be optional for areas not requiring peening and whose surface finish is not critical.

3.3.4 Magnetic particle or penetrant inspection. Unless otherwise specified, where magnetic particle or penetrant inspection is required, parts shall be subjected to such inspection in accordance with MIL-I-6868 or MIL-I-6866 before and after peening.

3.3.5 Sustained stress (preload). Unless otherwise specified, peening shall be accomplished on parts or areas of parts which do not have any sustained stress as the results of fabrication. When manufacturing operations induce residual stresses which may be detrimental to service after peening, the part shall be given a suitable stress relief heat treatment prior to peening.

3.4 Peening procedures.

3.4.1 Peening intensity. Unless otherwise specified on the drawings or in the contract, the peening intensity as indicated by a specified arc height value shall be as listed in Table IV for the thickness involved. If only a minimum intensity is specified, the maximum intensity should not exceed the minimum intensity by more than 0.004A for steel shot or 0.006N for glass beads. The maximum intensity shall not cause undue warpage of the part and shall be below the threshold of erosion of the basis material. Unless otherwise specified, for peening to intensities where the arc-height-inch is stated as A and C, metallic shot shall be used and where the arc-height-inch is stated as N, glass beads shall be used.

Table IV - Peening Intensity for Complete Coverage
in Arc-Height-Inch 1/ 2/

Thickness-Inch	Materials				
	Steel- 200 KSI or less	Steel-over 200 KSI	Titanium and titanium alloys	Aluminum and aluminum alloys (metallic steel shot) 3/	Aluminum and aluminum alloy (glass beads)
Up thru 0.090	0.003 to 0.006A	0.003 to 0.006A	0.003 to 0.006A	-	0.004 to 0.008N
0.091 to 0.375	0.006 to 0.012A	0.006 to 0.010A	0.006 to 0.010A	0.006 to 0.010A	0.008 to 0.012N
0.376 and over	0.012 to 0.016A	0.006 to 0.010A	0.006 to 0.010A	0.010 to 0.014A	0.012 to 0.014N

1/ The suffix letter A indicates that the values have been determined by the use of the test strip A (see 4.3.2). Test strip A is used for arc heights up to 0.024A. For greater intensity test strip C should be used. Test strip N is used if the intensity is less than 0.004A (see 6.9).

2/ Magnesium alloy responds to peening is different from that of other materials. It is essential to avoid broken or deformed peening media. Peening must be done with such media and under such conditions which do not induce cracks.

3/ Cast steel or stainless steel cut wire shot as specified.

3.4.2 Coverage. Areas of parts, peened as referenced on applicable drawings, purchase orders or contracts, shall be peened to complete 100 percent visual coverage (see 4.2.4 and 6.10). Each portion of the critical surface shall show visible evidence of plastic flow, that is a uniform peened or hammered appearance, to indicate complete coverage and obliteration of the original surface finish as indicated by overlapping impressions. On parts having a hardness of Rockwell C50 and greater, such coverage appearance may not be apparent. However, such parts shall show a noticeable difference in luster from an unpeened part. The length of time to achieve complete visual coverage shall be measured. Unless otherwise specified, the final operation shall last twice the time for steel shot and four times as long for glass bead shot, that is 200 percent minimum coverage for steel shot and 400 percent minimum coverage for glass shot. Coverage for holes and internal diameters shall be in accordance with Table V.

Table V - Coverage for Holes and Internal Diameters

Nominal Hole Diameter-Inch	Ratio-Diameter to Depth	Minimum Coverage-Percent
0.750 or greater	Any	200
Less than 0.750	1 or greater	200
Less than 0.750	Less than 1	100 to depth of 1/2 inch diameter

3.4.3 Area limitations. Unless otherwise specified, the variations in boundaries of areas to be peened, when limited, shall be -0 to + 1/8 inch.

3.4.4 Shot selection. The nominal shot size shall be the smallest size practical to produce the required intensity.

3.4.4.1 Fillet surfaces. If fillet surfaces on parts are required to be peened, the shot or bead size used shall be such that the nominal diameter of the peening medium is not greater than one-half the smallest nominal fillet radius to be peened, except that the nominal diameter of the shot need not be smaller than 0.007 inch (Shot No. 70 of MIL-S-851) and the nominal diameter of the beads need not be smaller than 0.002 inch (No. 13 size of MIL-G-9954 or No. 24 of Table I) when fillet radii of less than twice these dimensions require peening.

3.4.4.2 Shielded areas. If the shot or beads must pass thru slots, recesses or apertures to peen required shielded surfaces, the nominal diameter of the peening medium shall not be greater than 25 percent of the diameter or width of the opening, except that limitations as to minimum shot and bead specified for peening fillets (see 3.4.4.1) shall also apply. Except as otherwise specified or permitted, such as when shielded areas are involved, nonferrous materials shall not be peened with shot smaller than the following for the intensities given:

Intensity	Shot Numbers (MIL-S-851)	
	Types I and II (cast iron and steel)	Type III (cut wire)
0.012A	280	CW28
0.016A	390	CW41
0.020A	550	CW54

3.4.5 Angle of impact. The nozzle or nozzles of the equipment shall be kept as nearly as possible at an angle of 90 degrees to the surface of the part being peened. Effective peening intensity will vary directly as the sine of the angle of impact. Nozzle angles approaching 45 degrees will not produce residual compressive stress on the surface of parts.

3.5 Post-treatments.

3.5.1 Post operations. After peening, areas of parts shall still be within the dimensional and surface finish requirements. No manufacturing operations, such as straightening, grinding, or etching which relieve stresses developed by peening or which develop detrimental residual stresses shall not be permitted after peening. If straightening is required for peened parts, any means other than peen forming shall be prohibited. When peened parts are heated after peening as for baking of paints or protective coating systems, for hydrogen embrittlement relief after electroplating or for other thermal treatments, the temperatures employed shall be limited as follows (see 6.12).

Titanium and Titanium Alloy Parts	800°F (427°C)
Carbon and Alloy Steel Parts	475°F (246°C)
Aluminum and Aluminum Alloy Parts	200°F (93°C)
Magnesium Alloy Parts	200°F (93°C)

3.5.2 Cleaning. After peening and removal of protective masking all shot, shot fragments and particles shall be removed from surfaces of parts. Only methods which will not erode or scratch surfaces shall be used. Aluminum and aluminum alloy parts which have been peened with steel shot shall be cleaned either by an approved cleaning solution or other methods (see 3.5.2.1) which will not erode, scratch or otherwise damage the surface. This shall also be applicable to titanium and titanium alloy parts. For improving the maximum adhesion of subsequent coatings, the peened surfaces may be treated just prior to coating application with a very fine aluminum oxide abrasive material.

3.5.2.1 Aluminum parts. Unassembled aluminum and aluminum alloy parts without inserts may be cleaned by immersion in a nitric acid solution for 20 to 40 minutes at 120° to 140°F (49° to 60°C). The solution shall consist of the following:

Nitric acid (Sp. gr. 1.42)		200 to 500 ml.
Water	To make	1.1.

Nitric acid base deoxidizer solutions used prior to the application of anodic and chemical conversion coatings may be used provided they meet the acid strength requirements (see 6.14).

3.5.3 Surface finish improvement. It shall be permissible to improve the surface finish after peening by polishing, lapping, honing or vapor blasting provided such operations do not generate temperatures in excess of the applicable limitations (see 3.5.1) and do not remove material layers in excess of 10 percent of the specified minimum arc-height for A and C intensities or in excess of 3 percent of the specified minimum arc-height for N intensities. For example, a part peened to a 0.007 A intensity may have up to 0.0007 inch or 0.7 mil removed.

3.5.4 Protection from corrosion. Peened parts shall be protected from corrosion during processing and until final coating, installation and packaging (see 5.1) is completed. The method of protection shall be as specified or approved in the contract or order.

3.5.4.1 Aluminum and aluminum alloy parts. For aluminum and aluminum alloy parts, it is recommended that peened parts either coated with a light corrosion-preventive oil, or given either an anodic treatment in accordance with MIL-A-8625 or a chemical conversion coating treatment in accordance with MIL-C-5541 within two days after completion of the shot peening operation.

3.6 Qualification of peening operator.

3.6.1 Demonstration of proficiency. To achieve qualified status, each peening operator shall demonstrate his skill and proficiency by satisfactorily conducting peening tests in accordance with 4.2.3 using the equipment, materials and tools which he is required for peening parts in production as well as by various production processes.

3.6.2 Record of proficiency. The facility using the peening operator will complete and retain a record of the peening operator's qualification.

3.6.3 Equipment and materials. The peening operator shall satisfactorily peen a specimen on each machine, with the applicable media, and all equipment which he is to use in production.

3.6.4 Record of peening variables. Information concerning peening variables shall be observed and recorded while the respective specimens are being peened. Factors to be recorded, which can affect the degree of intensity are as follows:

(a) Air pressure or wheel speed, nozzle size and type, nozzle palcement and direction.

(b) Size, shape, density and hardness of peening medium.

(c) Length of exposure time, angle of impact, peening medium flow rate or velocity of shot stream.

(d) Speed of work piece movement in either translation or rotation or both.

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(b) Size, shape, density and hardness of peening medium.

(c) Length of exposure time, angle of impact, peening medium flow rate or velocity of shot stream.

3.6.5 Properties of peened specimens. The peened specimens shall be tested and exhibit properties conforming to all requirements specified herein.

3.6.6 Eligibility for peening. No peening operator shall be permitted to perform any peening operation in connection with any contract until qualified.

3.6.7 Qualification tests. The qualification tests for peening operators shall consist of peening and inspection of specimens regularly used in production peening of the basis metals. The test shall be as specified in 4.2.3 under various conditions of materials and equipment settings.

3.6.7.1 Acceptance criteria. The peened specimen shall be considered satisfactory when the operator reproduces a coverage curve (see Figure 1) for the equipment within ±1 Mil Almen A.

3.6.8 Rejection and retest. When the operator fails on one specimen, he shall be permitted to submit two other specimens of the same saturation coverage curve. If either of these two specimens fail to conform to the requirements specified, the operator shall be disqualified. If reexamination is desired after the above tests, the operator shall be required to submit a complete series of saturation curves as specified in 3.6.7. In addition to the above, the operator will be required to submit one additional specimen of the saturation curve which resulted in the disqualification.

3.6.9 Report of tests. Upon successful completion of the specified tests, an inspection test report that contains the essential information shall be signed by a responsible official of the contractor.

3.6.10 Qualification maintenance.

3.6.10.1 Status maintenance. Qualified status of operators may be maintained by a continuing record of satisfactory workmanship in compliance with 3.6.10.3 or by successfully completing reexamination tests every six months as specified in 3.6.10.2. Examination or reexamination of an operator will be required whenever there is reason to question the operator's proficiency, equipment operation, or the quality of parts. Periodic reexamination will not be required for operators when records indicate a satisfactory level is being maintained in production peening.

3.6.10.2 Reexamination. This reexamination will be required when a continuous record of workmanship is not maintained. Operators shall be reexamined every 6 months by peening parts representative of production. When the operator fails the above test, he shall be reexamined in accordance with 3.6.8.

3.6.10.3 Continuous record of workmanship. The determination of a satisfactory record of workmanship shall be based on approval, periodical scheduled inspection of parts, or by nondestructive methods normally conducted by the contractor for inspecting production peening capable of disclosing improper coverage and insufficient intensity (see 4.3).

4. QUALITY ASSURANCE

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Peening intensity.

4.2.1 Sampling. At least one intensity determination as defined in 4.2.3 shall be made to represent each peening machine for each two hours of continuous operation or fraction thereof where cast iron shot or glass beads are used and for each eight hours of continuous operation or fraction thereof where cast steel or cut steel wire is used. In all cases, at least one intensity determination shall be made at the start and one at the finish of each operation change and at least once for each eight hours of continuous operation.

4.2.2 Test specimens. One test specimen shall be used for each intensity determination. Test specimens shall be A, C or N type as specified. They shall be made of SAE 1070 cold rolled spring steel properly hardened and then tempered between flats to the hardness stated in Table VI. All specimens shall be free from carburization and decarburization to the extent that the differences in hardness between the surface and a non-carburized or nondecarburized depth under the surface shall not be more than two points on the Rockwell Superficial 30N scale. Specimens shall be flat within the tolerances shown in Table VI, when measured with a gage of the form and dimensions shown in Figure 6 of MIL-S-13165. In determining flatness of the N type specimen, measurements shall be made from both surfaces of specimen and the results averaged. Sides and ends of the specimens shall be smooth.

Table VI - Test Specimen Requirements

Specimen	Type A	Type C	Type N
Dimensional - length, inch	3.000 ±0.015	3.000 ±0.015	3.000 ±.015
width, inch	0.745 to 0.750	0.745 to 0.750	0.745 to 0.750
thickness, inch	0.051 ±0.001	0.094 ±0.001	0.031 ±0.001
Flatness - inch	0.000 ±0.001	0.0000 ±0.0015	0.000 ±0.001
Rockwell hardness	C44 to C50	C44 to C50	A72.5 to A76

4.2.3 Test procedure. The test specimens, selected in accordance with 4.2.2 shall be examined for flatness and set for zero curvature position with a micrometer gage of the form and dimensions detailed in Figure 6 of MIL-S-13165. 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 specimen shall be attached, as shown in Figure 5 of MIL-S-13165, to the solid holder, as detailed in Figure 4 of MIL-S-13165, so that the surface of the test strip which contacted the gage shall be facing down. The test strip, mounted on the holding block, shall be supported on a fixture which stimulates in its exposure to the blast of the equipment, the critical surface of the part to be peened. Test specimens may also be retained in milled slots of a simulated part rather than the holder for testing. To achieve the required peening intensity for compliance with 3.4.1 and Table IV, the test specimen shall be exposed to the shot, the speed of work movement in translation and rotation, the air presure or wheel speed of the equipment, the work distance of the nozzle or wheel for a time that will be used for the production part or article to provide uniform surface coverage. After exposure, the test strip shall be removed from the holder and the amount of deflection shall be measured with the gage, always placing the unpeened side against the gage stem. A peened test strip shall not be repeened after being removed from the test strip holder.

4.2.4 Coverage. The peening operation shall be repeated for different exposure times with a fixed equipment setting using a series of test strips to obtain a series of test points to establish a coverage or saturation curve as illustrated in Figure 1. If the curve shows an arc height within ± 1 mil at full coverage point, the conditions shall be considered satisfactory. If the specified intensity cannot be obtained in a reasonable time, shot velocity or that of the shot size shall be increased for higher arc heights or decreased for lower heights as illustrated in Figure 1 and the test shall be repeated (see 6.10).

4.2.5 Intensity information. Test specimens shall accompany peened parts and shall be inspected along with the appropriate lot. The following information shall be recorded for each specimen.

(a) Lot number and other production control numbers.

(b) Part number and name.

(c) Number of parts in lot.

(d) Date peened.

(e) Shot peening machine identification, air pressure or wheel speed, nozzle size and type, nozzle placement and direction, velocities of shot stream (rotation, translation or combination).

(f) Shot material and size with length of exposure time to peening.

(g) Specified peening intensity and actual peening intensity as shown by accompanying test strip.

(h) Percentage coverage.

This information shall be kept on file for the period of the contract. Applicable information shall also be kept on file necessary for qualification of peening operators (see 3.6.2, 3.6.4 and 3.6.7).

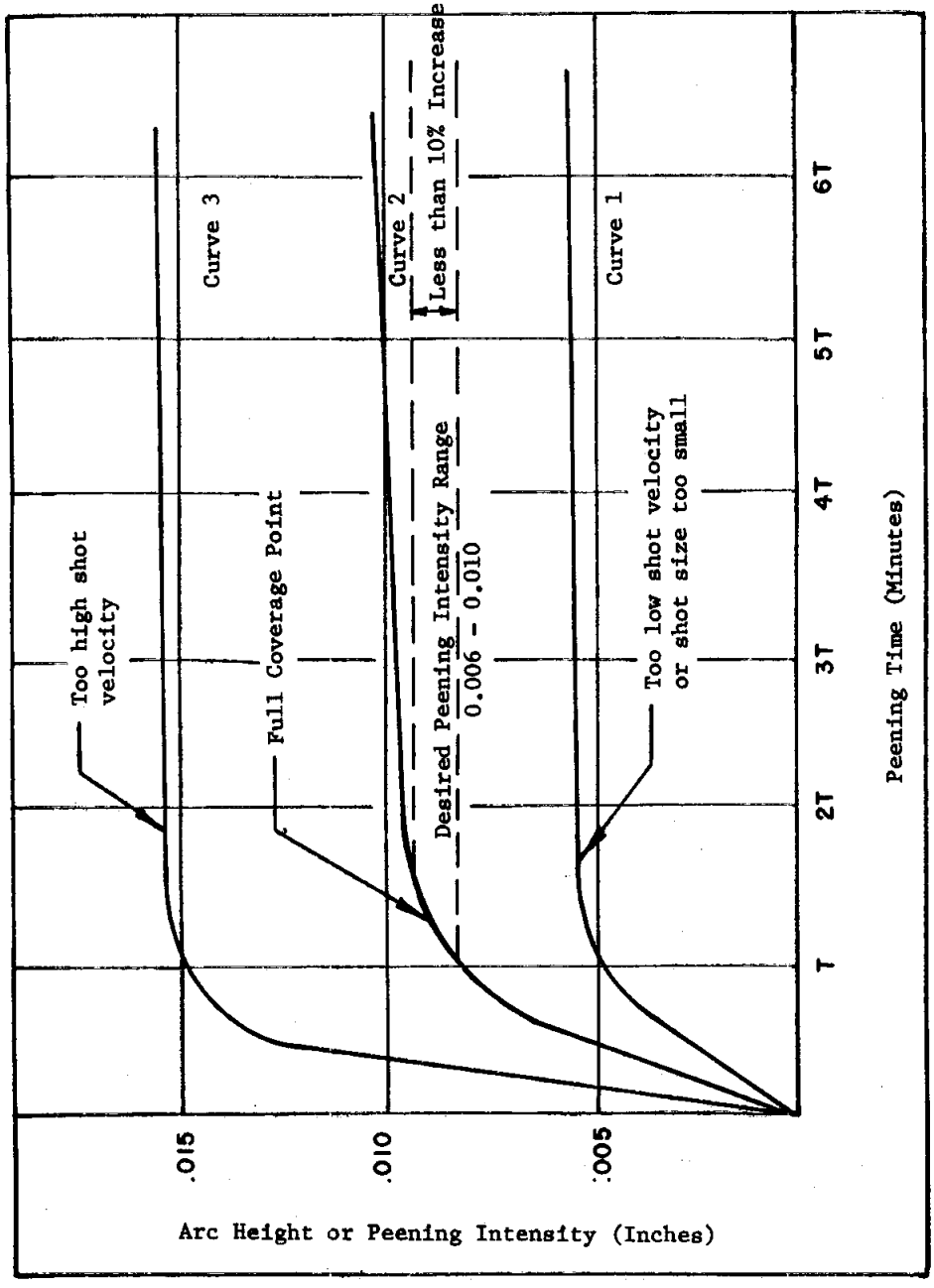

Figure 1 - 100% Coverage (Saturation) - Arc Height - Exposure Curve

4.3 Inspection of shot.

4.3.1 Sampling. At least one sample for determination for shot size and uniformity shall be taken for each two hours of continuous operation when cast iron shot is used or for each eight hours of continuous operation or fraction thereof when cast steel or cut wire shot is used. In all cases, whether metallic shot or glass beads are used, at least one sample shall be taken at the beginning and one at the end of each period of operation.

4.3.2 Visual examination. Cut wire shot and glass beads shall be examined for freedom from sharp edges, broken pieces and other defects detailed in 3.2.2. A single layer of cast shot which completely fills an area of 1, 1/2 or 1/4 square inch, as applicable for the shot number, shall be examined for deformed shot to determine conformance to 3.2.2 and Table II. The criteria for the determination of deformation shall be the acceptable and unacceptable shapes as shown in Figure 7 of MIL-S-13165.

4.3.3 Shot size. Sieves conforming to RR-S-366 shall be used for tests involving shot size and uniformity. Shot size distribution shall be determined for conformance to 3.2.1, 3.2.2, Table I and Table III as mixed, nonuniform shot is uneconomical and takes longer to obtain the correct intensity.

4.4 Inspection of peened articles.

4.4.1 Inspection lot. A lot shall consist of an identifiable quantity of parts or articles of the same metal composition, produced and formed under the same conditions, approximately of the same shape and size and subject to inspection at one time.

4.4.2 Sampling. Each peened part or article shall be examined to determine conformance to this specification with respect to coverage and workmanship. Examination for area limitations shall be made to insure conformance to the tolerances specified. On approval of the procuring activity, the supplier may use a system of statistical quality control for coverage, area limitation and workmanship examination.

4.4.3 Peened coverage. Articles shall be visually inspected at a magnification of 5X to 10X for compliance with the coverage requirement of 3.4.2. Visual examination shall show a uniform and complete overlapping impression, obliterating the original surface of the article. Holes shall be inspected with a suitable of optical instrument. Surfaces of articles shall be bare or coated with a light transparent oil.

4.4.4 Peening. The peening conditions, type of machine (air pressure or centrifugal), nozzles or wheels, size of nozzles or wheels, air pressure, wheel speed, work distance, material for shot, size of shot, work movement, exposure time, etc. per unit area shall be the same for parts or

articles being peened as for the test strips (see 4.2.3). For holes and internal diameter the requirements for 3.4.2 shall be used.

5. PREPARATION FOR DELIVERY

5.1 Packaging and packing. The preservation, packaging and packing methods for peened parts or articles employed by a supplier shall be such as to preclude any physical damage during handling and shipment (see 3.5.4).

6. NOTES

6.1 Intended use. Peening with metallic shot or glass beads is intended to induce surface compressive stresses in metal parts such as axles, springs (helical, torsional and leaf), gears, shafting, aircraft landing gear assemblies, wing structures, jet engine support members, helicopter rotor hub assemblies, etc. which are subjected to repeated applications of load pattern for the purpose of improving resistance to fatigue and stress corrosion cracking. Metallic shot peening is also used for applications such as to close porosity in castings and to straighten or form applicable parts. Peening with glass beads, is used primarily where contamination presents a special problem, where a fine surface finish is required, or when peening in a very sharp radius, such as a thread root, is required.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number and date of this specification.

(b) Particle distribution size of peening material, if other than specified (see 3.2.1).

(c) Size of peening media for charging into a machine if applicable (see 3.2.1).

(d) Methods for cleaning surfaces, if other than specified (see 3.3.2) and methods of stripping coatings, if applicable (see 6.11).

(e) Designations of locations to be peened, or locations to be free from peening, as applicable (see 3.3.3).

(f) If magnetic particle or penetrant inspection is required on peened parts (see 3.3.4).

(g) If externally applied forces are permissible during peening (see 3.3.5).

(h) Intensity requirement if other than specified (see 3.4.1).

(i) Requirements for coverage or limitations in obstructed areas, boundaries and other peening operations (see 3.4.2 and 3.4.3).

(j) Shot selection for shielded areas if other than specified (see 3.4.4.2).

(k) Cleaning solutions for peened parts, if applicable (see 3.5.2).

(l) Method of protecting peened parts from corrosion (see 3.5.4) and packaging (see 5.1).

6.3 Peening effects. Peening, to have the desired effects, requires that the specified intensity and coverage be achieved on critical areas, where high tension stresses or stress ranges are most likely to cause fatigue or stress corrosion failures in service. Actual experience with service failures or fatigue tests may sometimes be required to discover or form the locations of such areas subject to critical stressing, as a result of a combination of service, design, and fabricating conditions.

6.4 Sharp edges and holes. Sharp edges of parts, particularly edges of holes should be chamfered or radiused to prevent "roll over" during peening. The chamfer or radius should be as larger as practical but should not be less than 1/64 inch. The tendency for "roll over" will increase with increasing intensity of peening.

6.5 Areas accessibility. With shot peening shielded or partially shielded areas, walls of deep recesses or other areas less accessible to the maximum effects of the blasting will receive less peening as to intensity and coverage than the more favorable oriented areas. The surface of blind holes as small as 1/4-inch diameter and to a depth of about 8 inches can be peened with the same coverage and intensity as more accessible areas provided the right kind of equipment under controlled conditions are used.

6.6 Thin and small sections. The peening of very thin or small sections to high intensities should be avoided because of the distortion and high residual tensile stresses in the core material that may result from such peening. This is particularly true where the part has surfaces finished after heat treatment, or is used as a tension member.

6.7 Special procedures. Where special procedure is required, applicable drawings, contract or order must definitely designate such critical areas referred to in 6.3 as required by Section 3. This may be particularly important in instances referred to in 6.5, where such less accessible and unfavorable oriented surface, are, or may contain, areas subject to critical stressing.

6.8 Simple shapes. Relatively simple shapes and many open pitched helical spring designs may not require special mention as to critical areas since such areas are generally accessible to full peening effect when uniformly exposed to the peening blast stream.

6.9 Intensity comparison. For comparison of the nominal intensity designations, Type C test specimen deflection may be multiplied by 3.5 to obtain the approximate deflection of a Type A specimen when peened with the same intensity. Type A specimens are ordinarily used for arc heights up to 0.024 inch, for greater degree of peening Type C test specimens are used. For intensities below 0.004A the Type N test specimens shall be used. For comparisons of the nominal intensity designations, Type A specimen deflection may be multiplied by 3 to obtain the approximate deflection of a Type N specimen when peened at the same intensities (see 4.2.2).

6.10 Coverage. Full coverage can be established by plotting an arc height-exposure curve from a series of test strips as shown in Figure 1 , and assuring that the correct intensity (determined by the arc height of the test strip) falls on the right side of the knee of the curve. By doubling the time of exposure, the arc height of a test strip shall not increase by more than 10 percent.

6.11 Procedures for stripping. Anodic coatings should be stripped from aluminum and its alloys by immersion in a phosphoric-chromic acid solution at 212°F (100°C). The solution shall consist of either compositions as follows:

Phosphoric Acid	35 ml	4.5 fld oz
Chromic Acid	20 gm	2.7 av. oz
Water To make	1 l	1 gallon

6.12 Temperature limitations. Processing or service limitations of peened parts shall be limited to the temperatures in 3.5.1 unless test data for the specific applications support the satisfactory use of higher temperatures.

6.13 Shot size selection. In selecting shot sizes consideration shall be given to the following factors:

(a) Shape of part or article.

(b) Size of fillet radii or scratches (small shot to get into small fillets, etc. - see 3.4.4.1).

(c) Intensity desired (the size of shot limits the intensity which can be obtained in a given peening machine. Therefore, it may be necessary to use a larger shot to obtain high intensity or to reduce intensity requirements when shot must be small for consideration).

(d) Finish (At equal intensities, small shot will produce a finer finish, however, the time required for coverage increases rapidly with shot size).

6.14 Cleaning. The cleaning detailed in 3.5.2.1 for aluminum and aluminum alloy parts need not be performed by the peening operators provided it is performed prior to the application of any anodic coating or conversion chromatic coating.

6.15 Peening intensity. Figure 2 is offered as a guide and for information only showing the effects of air pressure versus intensity using glass beads for peening. Intensity will differ with nozzle size, impact angle, working distance, from one make of machine to another, etc. Similar results may be obtained using metallic shot.

Preparing activity:
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Figure 2

Typical Peening Intensities

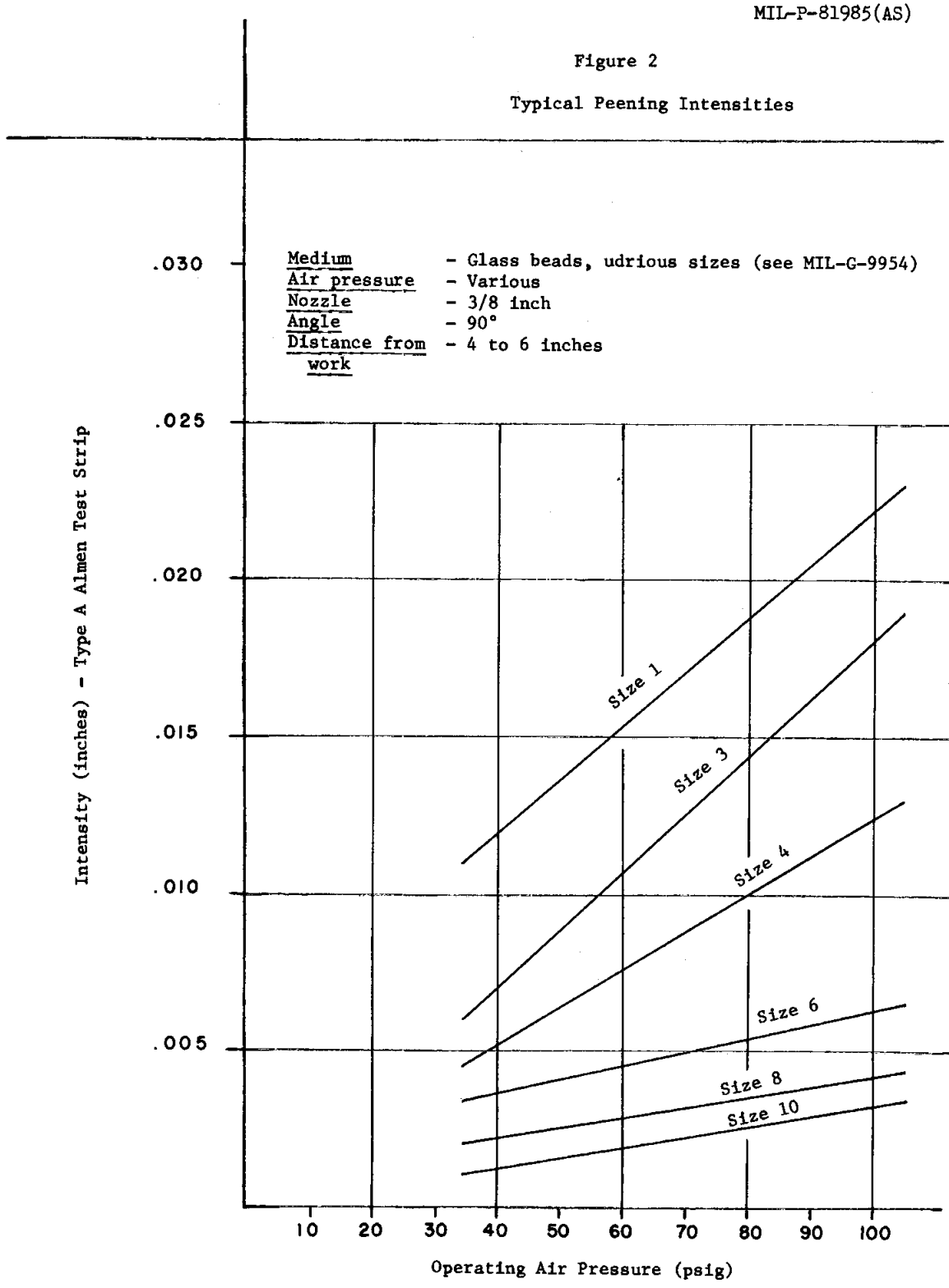

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Table I - Glass Bead Sizes
Percent Passing Through Sieves

Sieve Number 1/	Nominal Bead Size															
	331	280	232	197	165	138	117	98	83	70	59	49	41	35	29	24
18	100															
20	98-100	100														
25	-	98-100	100													
30	0-8	-	98-100	100												
35	0	0-8	-	98-100	100											
40		0	0-8	-	98-100	100										
45			0	0-8	-	98-100	100									
50				0	0-8	-	98-100	100								
60					0	0-8	-	98-100	100							
70						0	0-8	-	98-100	100						
80							0	0-8	-	98-100	100					
100								0	0-8	-	98-100	100				
120									0	0-8	-	98-100	100			
140										0	0-8	-	98-100	100		
170											0	0-8	-	98-100	100	
200												0	0-8	-	98-100	100
230													0	0-8	-	98-100
270														0	0-8	-
325															0	0-8
400																0

1/ Sieves shall be as specified in RR-S-366