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PEENSCAN^{sm} PROCESS
&
PEENSCAN PEN

INSTRUCTION MANUAL

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1. Introduction

What is the PEENSCAN PROCESS?

The PEENSCAN PROCESS is a method used to measure the amount and uniformity of "coverage" obtained during automatic, semi-automatic or manual shot peening of metal parts.

Coverage is technically defined as a uniform and complete denting or obliterating of the original surface of the part (or work piece) as determined by visual examination using a ten-power (10X) magnifying glass. However, it is sometimes difficult to visibly examine complex geometry areas using a ten-power glass. This includes fillets, cavities, grooves and holes, which are difficult to inspect because of inaccessibility of visual instruments.

The objective of the PEENSCAN process is to provide a practical way to measure coverage in terms of amount and uniformity via monitoring of the degree of removal of a fluorescent tracer dye, which is applied to the work piece. The PEENSCAN process uses specialty formulated tracer dye liquids known as DYESCAN fluids. The choice of an appropriate DYESCAN fluid is dependent on the hardness of the metal and the intensity of the shot peening process.

The PEENSCAN process facilitates quality control of the shot peening process.

What are the DYESCAN liquids?

The DYESCAN liquids are fluorescent tracer liquids employed in the PEENSCAN process. The two primary DYESCAN fluids are DYESCAN 220-2 and 220-6. When applied to a part, the liquids will dry and form a semi-elastic film. The primary solvent in DYESCAN 220-2 is Methyl Ethel Ketone (MEK), and the primary solvent in DYESCAN 220-6 is Isopropyl Alcohol.

DYESCAN fluorescent tracers are ultra-violet visible compounds that have a sensitivity somewhat less than that of the typical dyes used in Fluorescent Penetrant Inspection ("FPI"), but they are more sensitive than conventional color tracers such as dye-marker blue. Their fluorescent visibility under Ultraviolet (UV) light is clearly superior to 10X visual coverage, and is also outperforms other natural light ink coatings.

The residual DYESCAN, which remains on a part after shot peening, will identify flat spots and incomplete peening of surfaces. The uniformity of the DYESCAN liquid viewed under UV light after the shot peening process will give some evidence as to the degree of removal, or percentage of coverage that has been applied to the different part areas. It is possible to develop visual calibration standards for DYESCAN coated coupons that have been exposed to various degrees of shot peening coverage.

The optimal angle of impingement for removal of the DYESCAN liquid is 85 degrees from the part surface. Low angle of impingement and ricochet peening will not remove tracer coating without increasing the peening time, which risks erosion of the metal.

The DYESCAN liquids should be applied at room temperature. Temperatures above 90°F (32°C) can reduce the fluorescent brightness, and temperatures above 130°C can completely destroy the fluorescence capabilities of the DYESCAN liquids.

Exposure to low freezing temperature or high humidity also will affect the DYESCAN removal rate. The tracer liquids for the PEENSCAN process are not acids, and will not attack or contaminate customer parts. The liquid or dried DYESCAN materials can be removed by wiping with denatured Alcohol, Acetone or Methyl Ethyl Ketone (MEK) solvent. The DYESCAN liquids are intended primarily for use on steel substrates.

What are the PEENSCAN PENS?

Although the DYESCAN liquids can be applied by spray or wiping onto a part, the PEENSCAN PENS provide a convenient method to apply a thin coating of tracer to very specific areas of a part without the need for masking. This has proven useful during initial engineering set-up of a part for shot peening as well as for monitoring critical areas (gear teeth, etc.) during production shot peening.

2. PEENSCAN Process Potential Applications

1. Improved machine set-up to qualify uniformity of peening pattern of both machine and manual shot peening process. Uneven peening and hot spot concentration can be seen by the pattern of remaining coating. Note that the DYESCAN material removes best at an 85-degree angle of impingement. A low angle of impingement or low coverage will not be efficient at removing the tracer coating.

2. Where a magnifying glass is impractical, e.g. holes, fillets or large surfaces. To determine coverage on large surfaces such as vessels or other large parts where it is difficult to visually assure total coverage.

3. Batch Peening / Tumble Processing- Small parts coated with DYESCAN fluid and then shot peened together with quantities of uncoated parts can be checked to assure proper peening of the entire batch.

4. Quality Control

   (a) Improved Quality Control assurance for machined peened parts.

      (1) Detects poor shot flow.

      (2) Improper positioning of nozzles by operator during setup.

   (b) Operator can periodically check process by comparison to control specimen.

   (c) Inspector can re-verify process by checking same parts operator used.

   Note: Whenever varying levels of DYESCAN tracer coating remain on the part after the shot peening operation, it indicates that the area was not exposed to the same degree of shot peening coverage.

5. Manual Shot Peening

   Improved quality control of a manual shot peening operation is possible when the operator's technique is critical to attaining the appropriate level of shot peening coverage. A quick check under a UV light will indicate the sufficiency of the shot peening process. Use of the DYESCAN tracer coating enables inexperienced operators to refine their peening techniques and build confidence in coverage determination.

3. Using the PEENSCAN Process to inspect shot peened surfaces for coverage.

1. Set-up equipment to achieve the required peening parameters.

2. Prepare control specimen of the same material characteristics (alloy, hardness, etc.) as the production parts to be shot peened. The control specimen is to be used to compare the effectiveness of the shot peening process and also as a check of the shot peening process for subsequent production parts. The control specimen can be the First Article upon set-up.

3. Coat control specimen with the recommended DYESCAN liquid and allow it to dry. The number of specimens required will depend on set-up experience and the number of checks required during set-up run. See page 7 for the Method of Coating and page 6 for the DYESCAN product selection chart.

4. Inspect coating under UV light to insure completeness of the coating.

5. Peening uniformity check:
   (a) Shot peen coated part to an estimated level of 50% or less coverage.
   (b) Inspect under UV light to evaluate the uniformity of DYESCAN removal from the area requiring peening.
   (c) Refine machine set-up based on uniformity of DYESCAN removal. If adjustment is necessary, repeat steps (a) and (b) with a new coated part.
   (d) Shot peen the part at the required intensity to achieve 100% coverage as prescribed by the previously determined shot peening process specifications.
   (e) Examine the part and gauge the percentage of coverage verses percentage of DYESCAN fluorescent tracer that has been removed. In many cases, the fluorescent DYESCAN will be completely removed when 100% coverage is achieved. If the First Article part is used as a control specimen for this procedure, it should be re-peened during the production run to ensure that the min. degree of peening coverage has been attained, unless this conflicts with a max. peening coverage limit that may have been placed on the part.

5. Coat production parts with the same DYESCAN tracer formula (220-2 or 220-6). Dry and inspect the coating for completeness.

6. Shot peen the production parts until the amount of fluorescent visible under a UV light is equivalent with the amount of visible fluorescent on the control specimen.

   An additional use for the control specimen is to retain it to aid in subsequent set-ups. Comparison of the level of fluorescence on parts from a new set-up with the fluorescence on a control specimen from a previous set-up will indicate how consistent the set-ups are. The control specimen can also be used for the first and last piece check for quality control certification purposes.

4. DYESCAN Recommendations for Steel under varying Intensity & Shot Sizes

Steel 4340 (Rc 51 & 6 to 18A Intensity)

Regular Shot	70	- DYESCAN	#220-2
	110	- DYESCAN	#220-2
	170	- DYESCAN	#220-2
	230	- DYESCAN	#220-6
	550	- DYESCAN	#220-6
	1/8” BB	- DYESCAN	#220-6
Hard Shot	70	- DYESCAN	#220-6
	110	- DYESCAN	#220-6
	170	- DYESCAN	#220-6
	230	- DYESCAN	#220-6
Glass Beads	GB	- DYESCAN	#220-2

Steel 4340 (Rc 58 & 6 to 16A Intensity)

Hard Shot	110H	- DYESCAN	#220-6
	230H	- DYESCAN	#220-6

304 Stainless Steel (6A to 9C Intensity)

Regular Shot	110	- DYESCAN	#220-2
	230	- DYESCAN	#220-2
	1/8” BB	- DYESCAN	#220-2
Ceramic Shot	0.035”	- DYESCAN	#220-6

5. Method of Application and Equipment.

Coating Application

1. Clean part area to be coated. Hand wiping or degreasing with any customer-approved solvent that will remove the surface containments. Parts must be dry before applying the DYESCAN fluid with the PEENSCAN PEN.
2. Mask part as required, if necessary, before coating.
3. Coat only area to be shot peened. If the tip of the PEENSCAN PEN is dry, it will be necessary to depress it 5-10 times against a hard surface to get the DYESCAN liquid to flow. Apply the DYESCAN by lightly brushing the PEENSCAN PEN onto the part in the desired area. A light uniform coat is recommended. The tracer fluid may "puddle" in surface grooves and threads, so continue to brush it out to maintain an even coating. Handle wet parts carefully to avoid smearing or removal of coating. Allow parts to dry in room temperature air (60-80°F / 16-27°C.)
4. Inspect coating under UV light to insure completeness of the coating. If coating an oxidized surface, it may be difficult to determine whether coating coverage exists before peening. If in doubt, lightly scratch through the coating to expose base metal, and the contrast between the coated area and the bare metal will be readily visible.
5. Recoating of the shot peened area for calibration of coverage above 100% is allowed. The results from recoating the part and percentage of peening removal will be similar as for the original (or first) peening process with regard to confirming the uniformity of the peening process. However, the amount of DYESCAN tracer which remains on the part after subsequent peening runs will be more than after the first peening run because of tracer material which remains trapped on the cold worked surface.
6. Exposure of the dried DYESCAN fluid to temperatures above ambient can reduce fluorescent brightness. Temperatures above 130°F (54°C) will completely destroy the fluorescence. DYESCAN is not recommended for use on metals at freezing temperatures.
7. DYESCAN liquids are not acids and will not attack or contaminate metals. They are primarily recommended for use on steel substrates, but also have been used on aluminum, titanium and nickel based substrates. 100% removal of the DYESCAN liquid with shot peening is not always possible on soft metal substrates. With these metals it is necessary to carefully evaluate the amount of fluorescence that remains

on a control specimen that has been shot peened to a known coverage level, and then compare its fluorescence level to the uniformity and degree of fluorescence that is achieved on a production part.

8. Any excess or residual liquid or dried coating can always be removed with denatured Alcohol, Acetone or MEK solvent.
9. A water rinse should then follow the solvent cleaning step.

Equipment Required for PEENSCAN Process

Applicator:

Soft bristle brush, air spray brush or PEENSCAN PEN.

Inspection Area:

Dark room fitted with 40-watt red light limited to 2 foot-candles of illumination.

Subdued ambient light area limited to 5-foot candles of illumination.

Ultra Violet Light

100-watt high intensity, long wave UV radiation (3650 Angstrom Unit range) with purple glass filter. This will provide 1000 microwatts/cm^2 intensity at a 15" distance. The lamp should be used to inspect the coated part at a distance of 15 inches. When it is switched on, the UV lamp gradually takes 3-5 minutes to achieve full intensity. If the lamp is turned off, it must be cooled off before relighting.

Safety Note:

Do not wear photosensitive type glass lenses if you are using UV light.

6. Evaluating Fluorescent Removal

1. Un-coated areas will have a deep purple color when viewed under UV light.
2. Coated, unpeened metals will be bright in color when viewed under UV light. However, oxidized surfaces will tend to dull the fluorescence level. Lightly scratching through the coating will reveal a contrast between the underlying bare metal and the coated metal area.
3. In order to assess the shot peening coverage on a part, the shot peened part should be visually compared under UV light with the control specimen.

   Higher fluorescence levels on the shot peened part indicates:

   (a) Less peening coverage on the part. Check the set-up angle of impingement. Is the area being shot peened by ricochet peening or direct impact?

   (b) Trapped DYESCAN material. Examine the surface of the part. Rough machined or porous casting surfaces may trap the DYESCAN coating material where shot cannot reach. Also, the shot media may be too large for the radius of the area being peened. The root area of threads is an example of where the DYESCAN material can puddle and dry. Unless the shot size is small enough to reach into the root area of the thread and shot peen it, the DYESCAN material will show fluorescence under UV light.

   Lower fluorescence levels on the shot peened part indicates:

   (a) More peening coverage in inspected area.

   Note: All parts should be lightly blown off with a compressed air hose prior to inspection to remove any fluorescent dust on the part. Also, hands should be checked for fluorescence under UV light before handling or inspecting the part, because DYESCAN dust on the hands can be transferred back to the part. Both conditions could give false indications.

7. Safety Precautions

DYESCAN liquids contain volatile solvents. Use in well ventilated areas. Keep away from open flame, sparks and heat. Avoid contact with skin. Keep the PEENSCAN PEN cap closed when not in use to avoid evaporation. Do not inhale fumes. Always provide good ventilation in closed spaces when applying the fluid.

Handling and Storage.

- Do not mix different DYESCAN products.
- Mix thoroughly before using by shaking the PEENSCAN vigorously for several minutes.
- Clean up any spills with denatured Alcohol, Acetone or MEK.
- Solvents are FLAMMABLE. Keep away from open flames, sparks, heat or an ignition source.
- Store at room temperature to avoid degradation of fluorescent properties.

8. Independent Testing Laboratory Reports

List of elements found by independent laboratory analysis. Metal Improvement Company implies no guarantee of accuracy of the test or contents within the DYESCAN fluid.

	220-6	**220-2**
S - Sulphur	Less than 200 ppm	Less than 20 ppm
Cl - Chlorine	0.39 +/-0.01 ppm	Less than 20 ppm
Hg - Mercury	Less than 0.05 ppm	Less than 0.05 ppm
F - Fluorine	(less than 9.5 ppm)	NT
Pb - Lead	0.50 ppm	0.75 ppm
Cu - Copper	0.18 +/-0.02 ppm	ND (Less than 2.4 ppm)
Co - Cobalt	ND (Less than .009 ppm)	ND (Less than .07 ppm)
Br - Bromine	0.0471 +/-0.0079 ppm	NT
Mg - Magnesium	ND (Less than 2.5 ppm)	NT
Na - Sodium	15.6 +/-0.2 ppm	NT
V - Vanadium	ND (Less than 0.002 ppm)	NT
Al - Aluminum	0.30 +/-0.01 ppm	NT
Mn - Manganese	0.032 +/-0.004 ppm	NT
Freons	NT	Less than 50 ppm
Methanol	NT	Less than 500 ppm

ND – None Detected

NT – Not Tested