Appendix A. Peening Intensity Procedure

1. Previous Steps

Prior to determining peening intensity the correct set-up should be verified. Items to consider include the following:

- Shot type and size
- Impact angle
- Part holding fixture
- Translation speed
- Almen strip Holding fixture
- Indexing table accuracy
- Nozzle (and jet) size
- Targeting (Peenscan)
- Stand-off distance

2. Preliminary

Check the Almen gage for correct type (either No. 2 or No. 3) and check its calibration schedule. Inspect the gage for obvious defects, including worn indicator tip or balls. Use the Almen gage calibrator (flat side) to establish zero. Use the Almen gage calibrator (curved side) to verify gage accuracy of 0.024 within 0.0002" limit.

Select the appropriate Almen strip type (thickness):

- 'N' = .032" for low intensity
- 'A' = .051" for medium intensity (range 6A to 24A)
- 'C' = .094" for high intensity

If the strips are premium grade (group 1) or pre-certified, skip to the next section, otherwise check the following attributes:

1) length
2) width
3) thickness
4) flatness
5) hardness

Thickness. Place the Almen gage calibrator on the Almen gage with the flat side against the indicator tip. Be sure the indicator reads zero. Insert one end of the Almen strip between the flat side of the calibrator block and the indicator tip. Be sure the calibrator block stays firmly seated on the four support balls. The new reading on the indicator is the strip thickness.
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Flatness. Zero the Almen gage using the flat side of the calibrator block. Place the Almen strip on the gage firmly seated on the four support balls. The No. 3 Almen gage has end stops to centrally locate the proper strip position. The No. 2 gage requires you to estimate the central location of the strip. The new reading on the indicator is the strip flatness (also called pre-bow). You should also reverse the strip to check curvature on the opposite side. Strips may not have uniform thickness which can be detected by this extra step. Do not use strips with flatness beyond specification limits. Do not bend the strip to make it flat since it obviously has internal stresses that will tend to corrupt its accuracy.

3. Procedure

Place the Almen strip onto the Almen strip holder and tighten the 4 screws. Do not use excessive force. Be sure the strip holder is flat (within .0002") and that no shot is trapped under the strip. Expose the strip to the shot stream for the time indicated on your procedure sheet or blueprint. Remove the strip from the holder and measure its arc height.
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**Arc Height.** Zero the Almen gage using the flat side of the calibration block. Place the Almen strip on the gage firmly seated on the four support balls with the non-peened side touching the indicator stem. The new reading on the indicator is the arc height. Record this value in a table and on the graph for saturation curve. Do not re-use an Almen strip. A new strip must be used for each data point of the saturation curve. Repeat the above process using increasingly longer exposure times.

**Construct graph.** The data points from the table are represented graphically to determine the peening intensity. Plot the arc height on the vertical axis (Y) with exposure time (or number of machine cycles) represented by the horizontal (X) axis. Use a french curve to construct a smooth curve near the data points. Do not use straight lines and connect-the-dots.

**Determine intensity.** Select a point on the curve (not necessarily a plotted data point) that appears to be near the knee of the curve. Note the arc height and exposure time. Move to the right to double the exposure time and note the arc height value. If this value is within 10% of the previous value, then the previous value is the intensity. If more than 10% increase occurs then the original value is not intensity. You should focus on the curve and ignore the data points. It is unlikely that you might select exposure times that "exactly fit" the criteria for determining intensity.

**Acceptance.** Unless stated otherwise, the intensity should be within 4-points (± .002") of the requested intensity. Some prints or procedures may call out upper and lower limits (10A-14A). If the intensity is within the desired range you should record the following (required by Mil-S-13165 and AMS 2432):

1) Date  
2) Shot type and size  
3) Shot flow rate  
4) Air pressure (wheel speed)

![Graph](image-url)
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If the graph does not exhibit saturation (graph increases more than 10% for the data presented, then you must continue exposing more Almen strips for longer durations until saturation is achieved. If the graph does show saturation but you do not achieve the desired intensity you must change shot size, hardness or velocity and repeat the saturation test.

Higher intensity. To increase the peening intensity you must increase the shot size, hardness or velocity. Usually the velocity is adjusted by reducing the stand-off or increasing the air pressure or wheel speed. Smaller nozzles or changing the air jet size or setting can also increase the velocity. Reducing the shot flow rate will increase the shot velocity. Be sure that the targeting is correct. The highest intensity occurs at the central portion of the spray pattern. Also, be certain that the right size of shot is in use and it is not contaminated (dust, oil, water).

Lower intensity. Refer to above and do opposite.

Archive. Some procedures require that you retain the Almen strips as part of the record keeping procedure. Be sure to identify the strips adequately.

Intensity confirmation. The best way to confirm intensity is to repeat the above procedure use to determine intensity. However, most operators use a shortened procedure such as single point or double point confirmation. This may be at either saturation time or coverage (machine cycle) time. Although the shorter methods are prevalent, they are not described nor supported by MIL-S-13165 or by AMS 2432. If you use the shorter methods you should also include SPC charting to provide process control.
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4. Problems
Occasionally, the confirmation process shows a change in intensity. If you use method one (saturation curves) for intensity confirmation you have more information available for evaluating process change. The data points on the saturation curve may be close or scattered.

Shot size-wrong size
Shot size-distribution of sizes
Shot speed
Shot angle
Shot contamination- dust & fines
Shot contamination- oil & water
Shot contamination- obstruction
Almen strip- flatness
Almen strip- hardness
Almen gage- zero
Almen gage- calibration
Exposure time- Cycle timer
Exposure time- motion fault
Shot flow rate- incorrect rate
Shot flow rate- inconsistent
Targeting- nozzle fault
Targeting- motion fault
Machine modification or repair
Different brand or type of shot
Different brand or defective Almen strips
Different or damaged Almen gage
Nozzle wear or damage
Hose wear or damage
Wheel blade wear or damage
Machine fault - part not moving as expected
Machine fault - nozzle not moving as expected
Dust collector fault
Separator screen defect

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ºDon’t overlook the possibility of "Fabrication of Fictional Fables". There have been cases where a new operator could not achieve specified intensity. In one instance, after extensive investigation it was learned that previous operators were claiming to achieve intensity - but actually were not. The new operator was unaware that the records were altered to conceal the facts.