Shot Peening Intensity Determination

1. Previous Steps
Prior to determining peening intensity the correct set-up should be verified:

   Shot type and size
   Part holding fixture
   Almen strip holder fixture
   Nozzle size (and jet size)
   Stand-off
   Angle
   Translation speed
   Indexing accuracy
   Targeting (Peenscan)

2. Preliminary
Check the Almen gage for correct type (either #2 or #3) and its calibration schedule. Inspect the gage for obvious defects, including worn indicator tip and support balls. Use the Almen gage calibrator (flat side) to establish zero datum and set the indicator to zero. Use the Almen gage calibrator (curved side) to verify gage accuracy of 0.024 within 0.001" limit.

Select the appropriate Almen strip type:

   'N' = .032" for low intensity
   'A' = .051" for medium intensity
   'C' = .095" for high intensity

If the strips are pre-certified, skip to the next section; otherwise, check the following to the appropriate specification:

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

Items 1, 2 and 3 may need to be checked by your gage room. Items 4 and 5 can be checked with the Almen gage.
**Thickness.** Place the Almen gage calibrator block into position with the flat side touching the indicator stem. Be sure the indicator reads zero. Insert the (end) of the Almen strip between the indicator stem and the calibrator block. Be sure the calibrator block stays firmly seated against the gage balls. The new reading on the indicator is the strip thickness.

**Flatness.** Zero the gage, as shown earlier. Place the Almen strip onto the gage. If gage type #3 is used, place strip against back stops and end stop. If gage #2 is used place the strip against the back stop and centrally located along 3" axis (i.e., indicator stem near mid-length of Almen strip). The new reading on the indicator is the strip flatness (pre-bow).

3. **Procedure**
Place the Almen strip onto the Almen block and tighten the 4 screws. Do not use excessive torque. Be sure the block is certified flat and no contamination (i.e., shot, etc.) is beneath the strip. Expose the strip to the shot stream for the time indicated in the procedure table. If no table exists, then use the following values:

<table>
<thead>
<tr>
<th>Strip</th>
<th>Time</th>
<th>Arc Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30 seconds</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1 minute</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2 minutes</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3 minutes</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>4 minutes</td>
<td></td>
</tr>
</tbody>
</table>

Remove the strip from the block and determine its arc height.

**Arc Height.** Zero Almen gage as shown earlier. Place the strip onto the gage with the unpeened side touching the indicator stem. For gage type #3 be sure strip is against end stop. The new reading on the indicator is the arc height. Record this value in the table.

Do not re-use an Almen strip. Use a new Almen strip for each exposure time. Repeat the above process for the remaining strips.
Construct Graph. The data points from the table can be represented graphically and this will allow the determination of intensity. Plot the arc height on the vertical axis (y). The horizontal axis (x) is used for exposure time. Use a French curve to draw a line that best fits the points on the graph. Do not use a straight edge to directly connect point-to-point.

Read Intensity. Select a point on the curve (not necessarily one of the collected data points) that appears to be near the "knee" of the curve. Note the (x) axis value (time) and (y) axis height. Move to the right a distance that is equal to twice this time and note the new (y) axis value. If this new (y) axis value is 10% greater than the first (y) axis value, then the first (y) axis value estimate is not "intensity". Continue selecting estimates and reading the double time values until the increase in height is equal to 10%. It is important to note that you should focus on the curve, not your original data points. It would be extremely rare that you could select peening exposure times that "exactly fit" the criteria for interpreting intensity.

Acceptance. Unless stated otherwise, the interpreted intensity should be within 4 points (± 0.002") of the requested intensity. Some prints call out an upper and lower limit (i.e., 10-14A).

If the intensity is within the range requested you should record the following:

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

If the graph does not exhibit saturation (i.e., graph increases more than 10% for data presented) then you must continue exposing more strips at longer time intervals until saturation is achieved. If graph does how saturation and your intensity is not within the acceptable intensity range, you must adjust the machine and repeat the procedure.

Higher Intensity. To increase peening intensity you must increase the shot size or velocity. Usually, the velocity is adjusted by increasing the air pressure (or wheel speed). However, for air peening leaner flow rates will also provide higher velocity. Nozzle size (and jet size for suction type nozzles) will also affect velocity. Usually, smaller nozzles will have higher velocity.
Lower Intensity. Refer to above paragraph and do opposite.

Archive. Some procedures require that Almen strips be preserved for audit trail. Be sure to mark the strips to adequately identify them. Do not expose strips to high temperature.

Intensity Reconfirmation: The correct procedure to use for later confirmation of intensity is identical to the above procedure.

Although some operators are allowed to use (2) strips for intensity confirmation, care must be taken to avoid gross errors. Since Almen Strip arc height is influenced by strip hardness, flatness and microstructure, a specific strip may have a significant error. The process of exposing a minimum of (4) strips and using a French curve to draw a best-fit line will accommodate these discrepancies and offer a much more accurate indication of intensity.