A DATABASE FOR SHOT PEENING PARAMETERS AND DESIRED RESIDUAL STRESS DISTRIBUTION

Ajit Jain
Research Scholar
BHEL
Industrial Co-operative Society Ltd.

ABSTRACT

Now it is a proven fact that shot peening is very useful treatment for the workpiece and machine parts to increase the life and to avoid the fatigue failure by inducing the compressive stresses. For generalising the uses and applications of shot peening the process must be comprehensive and easy to attract the design engineers and industrial engineers. To make them follow the shot peening applications the computer program can be made.

To make the appropriate computer softwares there is a strong need to accumulate the large volume of test data for shot peening parameters like peening intensity and residual stress pattern to achieve the finer results with minimum trials and experimentation to shot peen the common materials. The corelation with different almen strips A,N,C are available and presented here for reference only.

KEY WORDS
residual stress, stress gradient, almen intensity

RESIDUAL STRESS DISTRIBUTION
The distribution of the residual stress varies depending on the nature of the work piece material. The control of the parameters of the shot peening process must give the correct or desired pattern of the residual stress distribution.
**ALMEN INTENSITY**

The intensity is expressed as the Arc height of an almen test strip. The curvature formed in the test strip is a function of the mass of the shot, shot hardness, shot velocity, angle of impingement and the exposure time to the shot stream.

The intensity measurement is necessary for process control.

**Table 1. Scales of intensity of shot peening**

<table>
<thead>
<tr>
<th>Intensity of shot peening (Almen degree)</th>
<th>Type of test piece</th>
<th>Arc. HT in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 N</td>
<td></td>
<td>0.10</td>
</tr>
<tr>
<td>6 N</td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td>8 N</td>
<td>N</td>
<td>0.20</td>
</tr>
<tr>
<td>16 N</td>
<td></td>
<td>0.40</td>
</tr>
<tr>
<td>18 N</td>
<td></td>
<td>0.45</td>
</tr>
<tr>
<td>6A</td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td>8 A</td>
<td></td>
<td>0.20</td>
</tr>
<tr>
<td>10 A</td>
<td>A</td>
<td>0.25</td>
</tr>
<tr>
<td>20 A</td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td>24 A</td>
<td></td>
<td>0.60</td>
</tr>
<tr>
<td>7 C</td>
<td></td>
<td>0.18</td>
</tr>
<tr>
<td>9 C</td>
<td></td>
<td>0.23</td>
</tr>
<tr>
<td>11 C</td>
<td>C</td>
<td>0.28</td>
</tr>
<tr>
<td>21 C</td>
<td></td>
<td>0.53</td>
</tr>
<tr>
<td>23 C</td>
<td></td>
<td>0.58</td>
</tr>
</tbody>
</table>

0.1 mm A = 4A  
0.1 mm C = 4C  
0.1 mm N = 4N
ARC HEIGHT
The arc height is determined by measuring the deflection of test strip N, A or C which has been peened on one side only.

ALMEN STRIPS
Almen strips are manufactured from steel of carefully controlled structure and heat treated to ensure repeatability. They have the standard dimensions and are purely as a means of duplicating a peening intensity that has already been established on the specified part.

1. Almen ‘N’ scale for test piece of type N, low intensity of shot peening usually below 6A.
2. Almen ‘A’ scale for test piece of type A, medium intensity of shot peening usually between 6A to 24A.
3. Almen ‘C’ scale for test piece of type C, high intensity of shot peening above 24A.

RELATIONSHIP AMONG TEST STRIPS
The relationship among test strips N, A and C is shown in Fig. 1. The curve shows N, A and C strips readings for conditions of identical blast an exposure.
Co-relation of Peening Intensity as Mentioned on A, C and N Strips as checked on an Almen Gauge, (This Curve Shows N, A and C Strips Readin for conditions of Identical Blast) & Exposure

DEPTH OF STRESS

The design engineer needs information as how deep the compressive layer will extend and what the maximum compressive stress is. The compressive stress produced in shot peening increase in magnitude but decrease in depth with increasing hardness of the work piece. Even if the shot peening conditions are constant the residual stress on peened surface changes by the thickness of the strip.

COMPOUND CURVATURE

By peening the softer material or thin plate beyond a certain limit the compound curvature is obtained which is called improper or incorrect peening.

TEST DATA

Many test data have been collected for the computer software for various materials like spring steel SU p 6 (42-43HRC); spring steel hardness 407, spring steel 46 HRC, Ni alloys, SAE 4340, SAE 5147, SAE1074 etc.

These data have been evaluated and represented on the graph, and the curves obtained are shown as the hook.

These graphs have been plotted for residual stress v/s peening intensity maximum stress at the depth ), and stress on surface. We are collecting some more data on other materials such as aluminium and alloys etc, To get the finer results.
I. 130 Shot Size - 0.28 mm, Intensity 0.40 mmA
II. 230 Shot Size - 0.58 mm, Intensity 0.35 mmA
III. 330 Shot Size - 0.84 mm, Intensity 0.40 mmA

(Fig. (2))
TEST DATA
MATERIAL: SAE 4340
HARDNESS: 45 HRC

Fig. (3)
TEST DATA
MATERIAL: SPRING STEEL
SI MN Steel SUPG
HARDNESS: 42.43 HRC

I. Steel Shot Size - 0.7 mm, Intensity 0.45 mmA
II. Steel Shot Size - 0.7 mm, Intensity 0.4 mmA
III. Steel Shot Size - 0.7 mm, Cut Wires size - 0.2-0.3 mm
     Intensity 0.45 mmA
IV. Steel Shot Size - 0.4 mm, Intensity 0.25 mmA

Fig. (4)
I. Ni ALLOY GH-33
HARDNESS 32-36 HRC
SHOTS - GLASS
SHOT SIZE 0.05-0.15
INTENSITY- 0.1 mm A.

II. Ni ALLOY GH-37
HARDNESS 32-36 HRC
SHOTS - GLASS
SHOT SIZE 0.05-0.15
INTENSITY- 0.1 mm A.

III. Ni ALLOY, Ni, Co, Mo
HARDNESS 32-36 HRC
SHOTS - STEEL & GLASS BEADS.
SHOT SIZE 0.4
INTENSITY- 0.3 mm A.

III. Ni BASE SUPPER ALLOY
HARDNESS 32-36 HRC
SHOTS - STEEL & GLASS BEADS.
SHOT SIZE 0.4
INTENSITY- 0.3 mm A.

Fig. (5)
CONCLUSION

The future research activity should be directed towards:

1. standardizing the shotpeening parameters for desired residual stress pattern, further study and experiments are required to collect more data.

2. Determination of peening parameters is a time consuming procedure. An extensive database can be prepared to ascertain these parameters and desired residual stress distribution pattern.

3. Residual stress distribution depends not only on the peening parameters but on the prior processing of the workpiece material as well.

REFERENCES

- Dr. M.C. Sharma, Shotpeening and Blast Cleaning - 1996, ICSP & BC-1.
- Data Collected by Dr. M.C. Sharma in some experiments and from other sources.
- Indian Standards - IS 7001 : 1989 on Shot Peening of Steel Parts
- Dr. A. Niku. Lari - Shot Peening Theory & Application.
- The Various issues of "The Shot Peener" by Electronics incorporated Mishawaka U.S.A.
- The Various issues of "The Metal Finishing News" Published by MFN Switzerland.
- Various Web Sites on Internet related with Shotpeening.