Design Development and Analysis of Viscous Damper for Vibration Reduction in Hand Held Power Tool

Pramod Kavitke¹, Rohan Jamgekar²

¹ M.E (Mechanical Engineering) Research Scholar, Bharat Ratna Indira Gandhi College of Engineering, Solapur
² Assistant Professor & HOD Mechanical Engineering, Bharat Ratna Indira Gandhi College of Engineering, Solapur

A) Analytical Damper body Design:

Table 1 show the Ultimate Tensile strength and Yield strength in N/mm² for EN08

<table>
<thead>
<tr>
<th>Designation</th>
<th>Ultimate Tensile strength N/mm²</th>
<th>Yield strength N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN08</td>
<td>380</td>
<td>270</td>
</tr>
</tbody>
</table>

Factor of safety is taken as 20.

\[ f_{ca} = \frac{Ultimate\ Tensile\ Strength}{Factor\ of\ safety} \]

\[ f_{ca} = \frac{380}{20} = 19.0N/mm² \]

Hoope's stress due to exhaust gas pressure:

\[ f_{act} = \frac{Pd_{t}}{t} \]

\[ f_{act} = 0.3 \times 282 \times 4 = 1.4 \ N/mm² \]

As, \( f_{c} < f_{ca} \); Damper body is safe.

B) Analysis Damper body Design:

Geometry is modeled in catia and imported withigs format in Ansys workbench for analysis.
C) Analytical Design of Piston Rod:

Table 2 show the Tensile strength and Yield strength in N/mm² for EN08
Ref: (PSG – 1.12)

<table>
<thead>
<tr>
<th>Designation</th>
<th>Tensile Strength N/mm²</th>
<th>Yield Strength N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN24</td>
<td>800</td>
<td>680</td>
</tr>
</tbody>
</table>

Table 2: Ultimate Tensile strength and Yield strength in N/mm² for EN24

Factor of safety is taken as 20

$\sigma_{act} = \frac{W \cdot A}{\
\sigma_{all}}$

Direct Tensile or Compressive stress due to an axial load:

$Piston\ force = \frac{Pressure \times \pi}{4} \times 28^2$

Piston force = 184N

Calculate Actual compressive stress,

$\sigma_{act} = \frac{W \cdot \pi \cdot 12}{4}$
\[ f_{\text{act}} = 184 \times 10^{-12} \]
\[ f_{\text{act}} = 2.62 \text{ N/mm}^2 \]
\[ A_s, f_{\text{act}} < f_{\text{all}}; \]
Piston rod is safe in compression.

**D) Analysis of Design of Piston Rod:**
Geometry is modeled in catia and imported with igs format in Ansys workbench for analysis.

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**III. RESULT AND DISCUSSION**

Table 3 show the FEM results values.

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Maximum theoretical stress N/mm²</th>
<th>Von-Misses stress N/mm²</th>
<th>Maximum deformation mm</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damper body</td>
<td>1.4</td>
<td>1.6</td>
<td>1.36 x 10⁻¹³</td>
<td>Safe</td>
</tr>
<tr>
<td>Piston</td>
<td>2.62</td>
<td>2.9</td>
<td>4.63 x 10⁻¹³</td>
<td>Safe</td>
</tr>
</tbody>
</table>

*Table 3: FEM results*
IV. CONCLUSION

1. Maximum stress by theoretical method and Von-misses stress are well below the allowable limit, hence the damper body is safe
2. Damper body shows negligible deformation under the action of system of forces.
3. Maximum stress by theoretical method and Von-misses stress are well below the allowable limit, hence the piston is safe
4. Piston shows negligible deformation under the action of system of forces.

REFERENCES


