Series 8500 Expansion Compensators

- Sizes 3/4" through 4"
- Threaded, welded, flanged, and grooved steel pipe joints
- Male and female copper sweat ends
- Design pressure: 200 psig—see Copper Tube, Page 6
- Axial travel: 2" and 3"
- Fully enclosed and externally pressurized, multiply stainless steel bellows
- Internal guides maintain alignment
- Compact space-saving design

Temperature changes in heat transfer system piping, tubing, heaters, radiators, solar panels, and other equipment create expansion and contraction that must be absorbed. Expansion Compensators provide a maintenance-free, compact, economical, and reliable method of eliminating this problem.

The compact design of Expansion Compensators permits installation within tight spaces, and the inline construction minimizes pressure drop and heat loss. The metal bellows is fully enclosed, and internal and external guides maintain alignment.

All welded or high-temperature brazed construction eliminates the need for maintenance. They are assembly line produced for economy, and they are available from stock.

Design Features

- 2-ply laminated bellows for maximum flexibility and life. Media is external to bellows for all models
- Internal guide ring maintains alignment of inner pipe and housing, and contact of the bellows and housing
- Threaded model (8503) includes anti-torque key
- Clearance limits travel to compressed expansion
- Fixed pipe or tube end
- Housing provides external protection for bellows
- External guide ring maintains alignment of inner pipe and housing, and prevents contact of the bellows and pipe

Canadian Registration Number: 09278.59870YTNADD3

Hyspan stainless to stainless bellows weld technology:
- maximizes service life
- minimizes corrosion of dissimilar materials

Applications

Series 8500 Expansion Compensators are designed for installations where the principal movement is axial. Standard joints are designed for 2" or 3" axial compression (pipe expansion) and 0.5" extension. If the primary movement is extension (pipe contraction), the compensator can be preset at the factory. The piping system must include anchors to react the force produced by pressure thrust and the bellows spring constant, supports to react the weight of the pipe and media, and guides to ensure that the pipe alignment is maintained.

Refer to Table 2 for the intermediate guide spacing in the center of pipe runs.

Warranty

Full three year replacement warranty—see back cover.

Table 1 Thermal Expansion

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Copper Tube</th>
<th>Carbon Steel Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>7.6</td>
<td>4.7</td>
</tr>
<tr>
<td>50</td>
<td>11.9</td>
<td>7.7</td>
</tr>
<tr>
<td>75</td>
<td>16.2</td>
<td>10.7</td>
</tr>
<tr>
<td>100</td>
<td>20.6</td>
<td>14.1</td>
</tr>
<tr>
<td>150</td>
<td>27.2</td>
<td>18.7</td>
</tr>
<tr>
<td>200</td>
<td>34.5</td>
<td>22.3</td>
</tr>
</tbody>
</table>

Table 2 Intermediate Guide Spacing

<table>
<thead>
<tr>
<th>Nominal Size (inches)</th>
<th>Pressure (psig)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>7.7</td>
</tr>
<tr>
<td>1</td>
<td>11.9</td>
</tr>
<tr>
<td>1 1/4</td>
<td>16.3</td>
</tr>
<tr>
<td>1 1/2</td>
<td>19.4</td>
</tr>
<tr>
<td>2</td>
<td>26.8</td>
</tr>
<tr>
<td>2 1/2</td>
<td>31.3</td>
</tr>
<tr>
<td>3</td>
<td>38.8</td>
</tr>
<tr>
<td>4</td>
<td>47.1</td>
</tr>
</tbody>
</table>

Note: Linear thermal expansion of pipe or tube per 100 feet between 70°F and a saturated temperature.
### Steel Pipe Applications

#### 8503 Male Pipe Threads
#### 8505 Fixed Flange

**Flanges:** ASME A150 raised face dimensioned per ASME B16.5, 150 LB

**Housing, Guides, & Stops:** Carbon steel sheet & tube

**Bellows:** Laminated (multiply) ASTM A240 Type 321 or 304 stainless steel

**Pipe:** A240 Type 304 or 321 stainless steel per ASME B16.2

**Bellows:** Designed for sweat connection

**Advanced Bellows Weld Technology**
- minimizes corrosion of bellows weld technology:
- maximizes service life

Bellows weld technology:
- maximizes service life
- minimizes corrosion of dissimilar materials

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### Copper Tube End Applications

**NS/ANSI 372–Lead Free**

**Hyspan stainless to stainless weld technology:**
- maximizes service life
- minimizes corrosion of dissimilar materials

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### Table 3 Pressure & Force Data Types 8503, 8504, 8505 & 8506

<table>
<thead>
<tr>
<th>Part #</th>
<th>8503</th>
<th>8504</th>
<th>8505</th>
<th>8506</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (NPS)</td>
<td>Size</td>
<td>3/4</td>
<td>1</td>
<td>1 1/4</td>
</tr>
<tr>
<td>Effective Area (in²)</td>
<td>1.1</td>
<td>1.3</td>
<td>2.1</td>
<td>3.3</td>
</tr>
<tr>
<td>100 psi (psig)</td>
<td>1.1</td>
<td>1.2</td>
<td>2.1</td>
<td>3.3</td>
</tr>
<tr>
<td>150 psi (psig)</td>
<td>1.2</td>
<td>1.4</td>
<td>2.2</td>
<td>3.4</td>
</tr>
<tr>
<td>200 psi (psig)</td>
<td>1.3</td>
<td>1.5</td>
<td>2.4</td>
<td>3.7</td>
</tr>
<tr>
<td>300 psi (psig)</td>
<td>1.5</td>
<td>1.8</td>
<td>2.9</td>
<td>4.3</td>
</tr>
</tbody>
</table>

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### Table 4 Pressure & Force Data Types 8509 & 8510

<table>
<thead>
<tr>
<th>Part Number</th>
<th>8509</th>
<th>8510</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (NPS)</td>
<td>Size</td>
<td>3/4</td>
</tr>
<tr>
<td>Effective Area (in²)</td>
<td>1.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Tabulated Pressure Thrust (pounds)</td>
<td>1.1</td>
<td>1.3</td>
</tr>
</tbody>
</table>

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### Table 5 Steel Pipe Ends—Models 8503, 8504, 8505 & 8506

<table>
<thead>
<tr>
<th>Nominal Size (NPS)</th>
<th>Spring Rate (lb/in)</th>
<th>Outside Diameter (inches)</th>
<th>Part Number</th>
<th>Axial Compr. (inches)</th>
<th>Overall Length (inches)</th>
<th>Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>81</td>
<td>58</td>
<td>214</td>
<td>2.375</td>
<td>214-2</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>88</td>
<td>63</td>
<td>2.875</td>
<td>219-2</td>
<td>2.0</td>
</tr>
<tr>
<td>1/2</td>
<td>75</td>
<td>52</td>
<td>229</td>
<td>2.875</td>
<td>222-3</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>1/4</td>
<td>121</td>
<td>82</td>
<td>3.500</td>
<td>227-3</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>3/4</td>
<td>143</td>
<td>117</td>
<td>4.000</td>
<td>231-3</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>187</td>
<td>132</td>
<td>5.000</td>
<td>235-3</td>
<td>3.0</td>
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<tr>
<td></td>
<td>6</td>
<td>230</td>
<td>156</td>
<td>5.563</td>
<td>239-2</td>
<td>2.0</td>
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<tr>
<td></td>
<td>8</td>
<td>284</td>
<td>199</td>
<td>6.625</td>
<td>248-3</td>
<td>3.0</td>
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</table>

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### Table 6 Copper Tube Ends—Models 8509 & 8510

<table>
<thead>
<tr>
<th>Copper Tube Size</th>
<th>Actual Tube O.D. (inches)</th>
<th>Axial Spring Rate (lb/in)</th>
<th>Outside Diameter (inches)</th>
<th>Part Number</th>
<th>Axial Compr. (inches)</th>
<th>Overall Length (inches)</th>
<th>Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>.875</td>
<td>62</td>
<td>44</td>
<td>2.26</td>
<td>22-1</td>
<td>2.0</td>
<td>12.750</td>
</tr>
<tr>
<td></td>
<td>1.125</td>
<td>52</td>
<td>43</td>
<td>2.26</td>
<td>22-2</td>
<td>2.0</td>
<td>12.750</td>
</tr>
<tr>
<td></td>
<td>1.375</td>
<td>62</td>
<td>43</td>
<td>2.26</td>
<td>22-3</td>
<td>2.0</td>
<td>12.750</td>
</tr>
<tr>
<td></td>
<td>1.625</td>
<td>62</td>
<td>43</td>
<td>2.26</td>
<td>22-3</td>
<td>2.0</td>
<td>12.750</td>
</tr>
<tr>
<td></td>
<td>2.125</td>
<td>109</td>
<td>78</td>
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<td>22-3</td>
<td>2.0</td>
<td>12.750</td>
</tr>
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<td></td>
<td>2.625</td>
<td>214</td>
<td>148</td>
<td>4.02</td>
<td>22-3</td>
<td>2.0</td>
<td>12.750</td>
</tr>
<tr>
<td></td>
<td>3.125</td>
<td>171</td>
<td>119</td>
<td>4.53</td>
<td>22-3</td>
<td>2.0</td>
<td>12.750</td>
</tr>
<tr>
<td></td>
<td>4.125</td>
<td>235</td>
<td>166</td>
<td>5.61</td>
<td>22-3</td>
<td>2.0</td>
<td>12.750</td>
</tr>
</tbody>
</table>

---

**Note:** Standard construction is designed for 2” or 3” axial compression and 0.5” axial extension. Refer to Ordering Instructions on Page 7 to order factory preset for axial extension.
Copper Tube Pressure Limits, Models 8509 and 8510
ASME B31.3 for Type L Copper Tubing has the following pressure and temperature limits (applies to Table 6, Page 5):

**Design Temperature for 200 psig as follows:**
- **3/4” and 1” Sizes:** 400°F
- **1 ¼” - 2” Sizes:** 350°F
- **2 ¼” - 3” Sizes:** 300°F
- **4” Size:** 175°F

**Copper Tube Pressure Limits, Models 8509 and 8510**

**Anchor Forces**
The axial expansion or contraction of pipe or tube is determined by the change in temperature. Table 1 on Page 3 includes a tabulation of linear change in inches for 100 feet of commonly used materials based on an installation temperature of 70°F. For installation temperatures above 70°F, subtract the expansion for the installation temperature from the service temperature, and add for installations below 70°F.

The Intermediate Guide Spacing in Table 2 on Page 3 is the minimum recommended guide spacing required to ensure that the pipe or tube travel is translated to, and aligned with, the compensators.

**Travel Required**

**Anchor Forces**
Systems incorporating expansion compensators must include structural reactions or main anchors as shown on the application diagrams (Page 3) with sufficient strength to withstand the full pressure thrust based on the effective area of the compensator, and the spring force produced by deflecting the bellows element. The highest pressure anticipated during service or testing should be used, and the maximum stroke for the most conservative design.

Ideally, intermediate anchors have balanced forces on each side; however, it is recommended that the maximum force produced by the compensator spring rate should be utilized for design.

**Main Anchor Force (lbs)**

\[
\text{Pressure Force (lbs)} = \left( \frac{\text{Spring Rate (lb/in)}}{\text{Column 2 Table 5 Models 8503-6 or Column 3 Table 6 Models 8509 & 10}} \right) \times \text{Axial Travel (inches)}
\]

**Intermediate Anchor Force (lbs)**

\[
\text{Spring Rate (lb/in)} = \left( \frac{\text{Column 2 Table 5 Models 8503-6 or Column 3 Table 6 Models 8509 & 10}}{\text{Axial Travel (inches)}} \right)
\]

**Important:** Hyspan compensators are manufactured with restraints to insure the rated movements. For cold applications or other special conditions, the factory must be notified in order to properly preset the units for extension applications.

**Travel:**
**Axial**

- **Minimum Temperature:** -325°F (192 psig at 200°F)
- **2” NPS:** 200 psig at 500°F maximum
- **2.0” axial travel maximum**

**Flow Direction:** The flow can be in either direction for Series 8500 Expansion Compensators.

**Shipping Restraints/Bars Removed?**

- **CAUTION:** Shipping Bars are not designed to react the pressure thrust of the compensator—they must be removed prior to testing.

**Post Installation Inspection:**
1. Inspect the expansion joint for damage
2. Is the compensator installed at the correct length and alignment?
3. Are the guides and support free to allow movement of the compensator?
4. Are the Shipping Restraints/Bars removed?

**Calculating Force:**

\[
\text{Force (lbs)} = \left( \frac{\text{Travel Required (inches)}}{100} \right) \times \text{Linear change from Table 1}
\]

**Spring Rate (lb/in):**

\[
\text{Spring Rate (lb/in)} = \left( \frac{\text{Travel Required (inches)}}{100} \right)
\]

**Spring Force (lbs):**

\[
\text{Spring Force (lbs)} = \left( \frac{\text{Travel Required (inches)}}{100} \right) \times \text{Linear change from Table 1}
\]

**Optional materials:**
- Model(s) 8503, 8504, 8505, and 8506 are available with all stainless steel construction for low temperature or highly corrosive service. Please specify when requesting pricing.

**Optional materials:**
- All Series 8500 Compensators are available with Bellows Material of:
  - ASTM A240-304, 304L
  - ASTM A240-321
  - ASTM B443-625 GR.1

**Important:**
- Hyspan compensators are supplied with a label attached stating the Design Pressure, Test Pressure, and Maximum Operating Temperature. Compensators are available for 2” and 3” axial travel. Consult the purchase specification for the allowable travel of the product purchased.

**Brazing & Soldering:** Type 8509 & 8510 copper tube end compensators incorporate silver brazed joints in the manufacturing process. Do not exceed 1000°F during installation.

**Ordering Instructions**

Refer to Tables 5 & 6 on Page 5 for the steel pipe or copper tube end configuration required for your application. If the travel required is unknown, see the method of calculation on Page 6.

**Ordering Instruction**
- **Example:**
  - Threaded steel pipe ends
  - 200 psig at 500°F maximum
  - 2.0” axial travel maximum
  - 2” NPS

**Series 8500**

- **Ordering Instruction**
  - **Important:**
  - Hyspan compensators are manufactured with restraints to insure the rated movements. For cold applications or other special conditions, the factory must be notified in order to properly preset the units for extension applications.

**Installation Procedure**

**Operating Conditions:** Series 8500 Expansion Compensators are supplied with a label attached stating the Design Pressure, Test Pressure, and Maximum Operating Temperature. Compensators are available for 2” and 3” axial travel. Consult the purchase specification for the allowable travel of the product purchased. Be certain that the system conditions and test conditions do not exceed these values.

**Guides, Supports, Anchors:** Series 8500 Expansion Compensators are designed for applications where the principal movement is axial to the centerline of the compensator, and the system includes guides, supports, and anchors. Refer to Applications on Page 3 for system requirements.

**Flow Direction:** The flow can be in either direction for Series 8500 Expansion Compensators.

**Brazing & Soldering:** Type 8509 & 8510 copper tube end compensators incorporate silver brazed joints in the manufacturing process. Do not exceed 1000°F during installation.

**Optional materials:**
- Model(s) 8503, 8504, 8505, and 8506 are available with all stainless steel construction for low temperature or highly corrosive service. Please specify when requesting pricing.

**Optional materials:**
- All Series 8500 Compensators are available with Bellows Material of:
  - ASTM A240-304, 304L
  - ASTM A240-321
  - ASTM B443-625 GR.1

Please specify when requesting pricing.
THREE YEAR LIMITED WARRANTY

This warranty (abbreviated here) is given by HYSPAN PRECISION PRODUCTS, INC. (HYSPAN) for the benefit of the purchasers for use of its Series 8500 Expansion Compensators manufactured by HYSPAN to standard catalog construction or standard construction with laminated Alloy 625 bellows. The product is warranted to be free from defects in material and workmanship for a period of three (3) years from the date of shipment by HYSPAN in accordance with the conditions stated on HYSPAN’S official website; www.hyspan.com.

For complete warranty terms and conditions, please see Series 8500 warranty at www.hyspan.com.