ITT Infrastructure Products
Global Presence

ITT is a diversified leading manufacturer of highly engineered critical components and customized technology solutions for growing industrial end-markets in energy, infrastructure, electronics, aerospace and transportation. Building on its heritage of innovation, ITT partners with its customers to deliver enduring solutions to the key industries that underpin our modern way of life.

ITT Enidine provides custom seismic isolation products for unique infrastructure applications worldwide.

ITT Enidine’s engineering staff and technical sales personnel are available to assist you with all of your application needs.

• With a proven track record of operating with lean manufacturing, ITT Enidine produces higher quality custom products with greater efficiency and within shorter lead times.

• ITT Enidine manufactures all of our products in-house, giving you fast reliable service to meet your critical application needs with on-time delivery.

• Here at ITT Enidine we have a proven track record in the infrastructure market with cutting edge technologies and engineering support, we can provide a custom solution to meet any need globally.

Our website features a worldwide representative lookup to help facilitate fast, localized service at www.enidine.com. For application assistance call our help line at 1.800.852.8508.

Founded in 1920, ITT is headquartered in White Plains, NY, with employees in more than fifteen countries and sales in more than 125 countries.

The company generated 2012 revenues of approximately $2.2 billion. For more information, visit www.itt.com.
Additional Custom Infrastructure Products and Solutions

Power & Utility Sub-Stations
- 6 degree of freedom isolator Ring
- Stainless Steel construction
- Retrofits to most transformer bushings with little or no modification
- Dynamically tested to IEEE 693

HVAC and Chiller Units
- Equipment Seismic Isolation Stand
- Combined Isolation Bearing, Elastomeric damping and Wire Rope Isolator technologies
- Protects equipment from vertical and horizontal seismic inputs
- No maintenance
- Chillers, HVAC, Medical Equipment

Power Plants
- WEAR™ Pipe Restraint/Vibration Isolator
- Nuclear, fossil generation plants, refineries and structural
- No oil, seals, greases or maintenance
- Compatible with most pipe attachment hardware

Oil and Gas Offshore Platforms
- Tuned mass dampers, generators, chillers and high value assets
- High or low damping configurations
- Can be applied in parallel with viscous damper technology
- 6 to 21 inch diameter

Refineries and Storage Facilities
- HERM
- Standard Product Selection
- Shipboard Design Expertise
- Electronics Isolation
- Systems Analysis and Integration
- Multi-Axis Isolation
- Minimum Sway Space
Infrastructure Products

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We Provide Highly Engineered Customized Solutions for Every Unique Customer.
LD Damper Series are typically recommended for use on TMD (Tuned Mass Damper) Systems or applications requiring high energy dissipation demand and tight space restrictions.

Maximum Force Reduced Due to Buckling Failure Mode. “Cylinder buckling load for cap pivot mounts determined in accordance with NFPA/T3.6.37 R1-2010, Hydraulic fluid power - Cylinders - Method for determining the buckling load.” Buckling load analyzed at mid-stroke damper position.

**Linear Damping Devices**

**LD-500 Series**

**Technical Data**

When ordering please specify the constitutive law damping coefficient $C$ (kN·sec/m), where $F = C \times V$.

<table>
<thead>
<tr>
<th>Catalog No./Model</th>
<th>Stroke (mm)</th>
<th>A (mm)</th>
<th>FMax. (kN)</th>
<th>3 Minutes (Watts)</th>
<th>10 Minutes (Watts)</th>
<th>Continuous (Watts)</th>
<th>Unit Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD510</td>
<td>100</td>
<td>290</td>
<td>4.0</td>
<td>238</td>
<td>88</td>
<td>47</td>
<td>0.7</td>
</tr>
<tr>
<td>LD515</td>
<td>150</td>
<td>365</td>
<td>4.0</td>
<td>280</td>
<td>104</td>
<td>58</td>
<td>0.8</td>
</tr>
<tr>
<td>LD520</td>
<td>200</td>
<td>440</td>
<td>3.0</td>
<td>322</td>
<td>121</td>
<td>69</td>
<td>0.9</td>
</tr>
<tr>
<td>LD530</td>
<td>300</td>
<td>590</td>
<td>2.0</td>
<td>402</td>
<td>154</td>
<td>91</td>
<td>1.2</td>
</tr>
<tr>
<td>LD540</td>
<td>400</td>
<td>740</td>
<td>1.4</td>
<td>482</td>
<td>187</td>
<td>113</td>
<td>1.4</td>
</tr>
</tbody>
</table>

*Maximum Force Reduced Due to Buckling Failure Mode. “Cylinder buckling load for cap pivot mounts determined in accordance with NFPA/T3.6.37 R1-2010, Hydraulic fluid power - Cylinders - Method for determining the buckling load.” Buckling load analyzed at mid-stroke damper position.

**Damping Configurations**

When ordering please specify the constitutive law damping coefficient $C$ (kN·sec/m), where $F = C \times V$. 

- Config1: 2.5 ≤ $C$ ≤ 4.0 (kN·sec/m)
- Config2: 2.0 ≤ $C$ ≤ 2.5 (kN·sec/m)
- Config3: 1.5 ≤ $C$ ≤ 2.0 (kN·sec/m)
- Config4: 1.0 ≤ $C$ ≤ 1.5 (kN·sec/m)
Linear Damping Devices
LD-700 Series

Technical Data

<table>
<thead>
<tr>
<th>Device</th>
<th>Stiffness Unit</th>
<th>Catalog No./Model</th>
<th>Power Dissipation Capacity</th>
<th>Device Stiffness (kN/m)</th>
<th>Unit Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 Minutes (Watts)</td>
<td>10 Minutes (Watts)</td>
<td>Continuous (Watts)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>400</td>
<td>140</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>150</td>
<td>170</td>
<td>65</td>
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<td></td>
<td></td>
<td></td>
<td>200</td>
<td>190</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>300</td>
<td>240</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>400</td>
<td>360</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>500</td>
<td>450</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>600</td>
<td>540</td>
<td>150</td>
</tr>
</tbody>
</table>


Damping Configurations

When ordering please specify the constitutive law damping coefficient C (kN·sec/m), where F = C x V.
Linear Damping Devices
LD-1100 Series

Technical Data

Power Dissipation Capacity

<table>
<thead>
<tr>
<th>Device Stiffness</th>
<th>3 Minutes</th>
<th>10 Minutes</th>
<th>Continuous</th>
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<tbody>
<tr>
<td></td>
<td>Watts</td>
<td>Watts</td>
<td>Watts</td>
</tr>
<tr>
<td>LD1110</td>
<td>2200</td>
<td>720</td>
<td>164</td>
</tr>
<tr>
<td>LD1115</td>
<td>2440</td>
<td>794</td>
<td>186</td>
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<tr>
<td>LD1120</td>
<td>2660</td>
<td>872</td>
<td>210</td>
</tr>
<tr>
<td>LD1130</td>
<td>3120</td>
<td>1026</td>
<td>258</td>
</tr>
<tr>
<td>LD1140</td>
<td>3580</td>
<td>1180</td>
<td>305</td>
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<tr>
<td>LD1150</td>
<td>4040</td>
<td>1340</td>
<td>352</td>
</tr>
<tr>
<td>LD1160</td>
<td>4500</td>
<td>1500</td>
<td>400</td>
</tr>
</tbody>
</table>

Damping Configurations

When ordering please specify the constitutive law damping coefficient C (kN–sec/m), where F = C x V

Seismic_Products_Catalog:Seismic_Products_Catalog  7/13/16  11:05 AM  Page 3
Linear Damping Devices
LD-1500 Series

Technical Data

<table>
<thead>
<tr>
<th>Catalog No./Model</th>
<th>Stroke (mm)</th>
<th>A (mm)</th>
<th>FMax (kN)</th>
<th>Power Dissipation Capacity</th>
<th>Device Stiffness (kN/mm)</th>
<th>Unit Weight (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 Minutes</td>
<td>10 Minutes</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>LD1510</td>
<td>100</td>
<td>600</td>
<td>200</td>
<td>8700</td>
<td>2720</td>
<td>330</td>
</tr>
<tr>
<td>LD1515</td>
<td>150</td>
<td>675</td>
<td>200</td>
<td>9700</td>
<td>3020</td>
<td>380</td>
</tr>
<tr>
<td>LD1520</td>
<td>200</td>
<td>750</td>
<td>200</td>
<td>10650</td>
<td>3320</td>
<td>425</td>
</tr>
<tr>
<td>LD1530</td>
<td>300</td>
<td>900</td>
<td>200</td>
<td>12500</td>
<td>3910</td>
<td>520</td>
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<tr>
<td>LD1540</td>
<td>400</td>
<td>1050</td>
<td>200</td>
<td>14400</td>
<td>4500</td>
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<td>500</td>
<td>1200</td>
<td>200</td>
<td>16300</td>
<td>5100</td>
<td>710</td>
</tr>
<tr>
<td>LD1560</td>
<td>600</td>
<td>1350</td>
<td>200</td>
<td>18200</td>
<td>5700</td>
<td>810</td>
</tr>
</tbody>
</table>

Damping Configurations

When ordering please specify the constitutive law damping coefficient C (kN–sec/m), where F = C x V
Fluid Viscous Damper
FVD-B Series

Technical Data

The FVD-B Series dampers are typically utilized on bridge and base isolation platforms requiring a long cycle life. This custom orifice designed damper provides the desired force versus velocity relationship symmetrically in both tension and compression directions, thermal compensation, and easy preventative maintenance inspection.

<table>
<thead>
<tr>
<th>Catalog No./Model</th>
<th>Max. Damping Force (kN)</th>
<th>Stroke at Mid-Stroke (mm)</th>
<th>Pin-Pin Mounting Pin Diam. (mm)</th>
<th>Max. O.D. Diameter (mm)</th>
<th>Inner Diameter (mm)</th>
<th>Height (mm)</th>
<th>Width (mm)</th>
<th>Weight (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVD-B-300-1200</td>
<td>300</td>
<td>600</td>
<td>3790</td>
<td>166</td>
<td>40</td>
<td>24</td>
<td>70</td>
<td>35</td>
</tr>
<tr>
<td>FVD-B-450-1200</td>
<td>450</td>
<td>600</td>
<td>3851</td>
<td>185</td>
<td>50</td>
<td>60</td>
<td>46</td>
<td>36</td>
</tr>
<tr>
<td>FVD-B-600-1200</td>
<td>600</td>
<td>600</td>
<td>3874</td>
<td>210</td>
<td>50</td>
<td>46</td>
<td>46</td>
<td>34</td>
</tr>
<tr>
<td>FVD-B-800-1200</td>
<td>800</td>
<td>600</td>
<td>3950</td>
<td>242</td>
<td>70</td>
<td>83</td>
<td>46</td>
<td>40</td>
</tr>
<tr>
<td>FVD-B-1000-1200</td>
<td>1000</td>
<td>600</td>
<td>4011</td>
<td>267</td>
<td>80</td>
<td>120</td>
<td>55</td>
<td>53</td>
</tr>
<tr>
<td>FVD-B-1200-1200</td>
<td>1200</td>
<td>600</td>
<td>4062</td>
<td>286</td>
<td>80</td>
<td>134</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>FVD-B-1500-1200</td>
<td>1500</td>
<td>600</td>
<td>4124</td>
<td>318</td>
<td>90</td>
<td>150</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>FVD-B-2000-1200</td>
<td>2000</td>
<td>600</td>
<td>4244</td>
<td>356</td>
<td>110</td>
<td>186</td>
<td>80</td>
<td>73</td>
</tr>
</tbody>
</table>

**Note:**
1. Various stroke lengths available. Pin-Pin length at mid-stroke position can be determined by adding 2.5 times the stroke change.
2. Velocity exponent \( \alpha \) is available from 0.2 - 1.0
3. Weighted dimensions are for reference only. Consult ITT Enidine Inc. for detailed information before placing orders.
4. Additional designs and modifications are available based on project specifications.

Damping Characteristics

\[ F = CV^\alpha \]

- \( F \): Damping Force, kN
- \( V \): Relative Velocity, m/sec
- \( C \): Damping Coefficient, kN/(m/sec)\(\alpha\)
- \( \alpha \): Velocity Exponent
Fluid Viscous Damper  
FVD-B Series  

Technical Data

Shown below are graphs depicting the damping force versus the velocity for various damping coefficients and velocity exponents. Refer to page 11 for how to specify the damping characteristics when ordering.
The FVD-H Series dampers are typically utilized on building applications, mounted indoors, where the damper is not under constant vibration or movement.

### Damping Characteristics

\[ F = CV^\alpha \]

- \( F \): Damping Force, kN
- \( V \): Relative Velocity, m/sec
- \( C \): Damping Coefficient, kN/(m/sec)^\alpha
- \( \alpha \): Velocity Exponent

### Technical Data

<table>
<thead>
<tr>
<th>Catalog No./Model</th>
<th>Max. Damping Force</th>
<th>Stroke ±S</th>
<th>Pre-Def. Mid-Stroke</th>
<th>Max. O.D.</th>
<th>Collar To Flange</th>
<th>Collar Diameter</th>
<th>Collar Depth</th>
<th>Collar Wall Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVD-H-500-150</td>
<td>500</td>
<td>75</td>
<td>96</td>
<td>142</td>
<td>51</td>
<td>70</td>
<td>89</td>
<td>48</td>
</tr>
<tr>
<td>FVD-H-750-150</td>
<td>750</td>
<td>75</td>
<td>1020</td>
<td>176</td>
<td>64</td>
<td>86</td>
<td>112</td>
<td>58</td>
</tr>
<tr>
<td>FVD-H-1000-150</td>
<td>1000</td>
<td>75</td>
<td>1070</td>
<td>198</td>
<td>77</td>
<td>104</td>
<td>134</td>
<td>67</td>
</tr>
<tr>
<td>FVD-H-1500-150</td>
<td>1500</td>
<td>75</td>
<td>1140</td>
<td>240</td>
<td>89</td>
<td>120</td>
<td>156</td>
<td>77</td>
</tr>
<tr>
<td>FVD-H-2000-150</td>
<td>2000</td>
<td>75</td>
<td>1210</td>
<td>286</td>
<td>112</td>
<td>135</td>
<td>178</td>
<td>86</td>
</tr>
</tbody>
</table>

- Note 1: Various stroke lengths available. Pin-pinion length at mid-stroke position can be determined by adding 2.5 times stroke length change.
- Note 2: Velocity exponent \( \alpha \) available from 0.2 - 1.0
- Note 3: Weight and dimensions are for reference only. Consult ITT Enidine Inc. for detailed information before placing order.
- Note 4: Additional designs and modifications are available based on project specifications.
Fluid Viscous Damper
FVD-H Series

Technical Data

Shown below are graphs depicting the damping force versus the velocity for various damping coefficients and velocity exponents. Refer to page 11 for how to specify the damping characteristics when ordering.
Short Stroke and Long Stroke
Fluid Viscous Dampers

**Short Stroke Dampers (FVD-H Series)**

High-Rise Buildings, Stadiums, City Centers and National Assets
- Viscous Dampers (Short Stroke) Buildings
- Forces up to 2 000 kN
- Diagonal or Chevron Brace mounts
- Velocity Exponent - Alpha 0.2 to linear
- In line, self contained spring loaded reservoir available
- Visual or electronic fluid monitoring system available

**Long Stroke Dampers (FVD-B Series)**

Bridges, Highway and Structures
- Viscous Dampers (Long Stroke) Bridges
- Forces up to 2 000 kN
- Strokes up to 2 000 mm
- Velocity Exponent - Alpha 0.2 to linear
- In line, self contained spring loaded reservoir
- Visual or electronic remote fluid monitoring system
- Resusable mechanical fuse option

**Research, Design and Engineering**

- Static Testing – Including precision electromechanical machines with programmable controllers
- Drop Testing – Up to 1 800 Kg and 15 m/sec.
- Vibration – Electromechanical shakers with digital controllers
- Dynamic Testing – Up to 2 220 kN at 2.0 m/sec.

- 3D CAD Software, Solidworks
- Finite Element Analysis, COSMOS
- Dynamic Software, Visual Nastran
Customer Focused Approach

At ITT we will develop products, process and solutions for new applications that will generate excitement among our business partners while setting new industry standards as a premier components supplier.

- Conduct Fundamental Research to Develop Innovations
- Work with Customer to Fully Explore Application/Issues and Engage all Stake Holders
- Provide Solutions, Options and Trade-offs
- Deliver on our Promises

Research and Development

ITT Enidine is active in the fundamental research community and chairs/presents at technical conferences.

Research collaboration with:
- University of California (Irvine)
- University of Buffalo (US)
- Federal University of Santa Catarina (Brazil)
- University of Liverpool (UK)
- The Boeing Corporation (US)
- Bombardier

Design and Development

- All capabilities for design and development in house
- Assemble and test quickly
- Innovation in Technology
- Engineering Experience

Market Focused Solutions

- 3-COM Data Center, Santa Clara, CA.
- Coronado Bridge, San Diego CA.
- Sakhalin Island, Tuned Mass Damper
- Trump Tower, New York, NY
- San Francisco Opera House
- Syncrude Oil Sands Project
- Major Chimney Suppliers in Japan
- Siemens Transformer Isolation

Focused Product Applications

- Power Sub-Stations & Utility Base Isolation
- High-Rise Buildings
- Bridges & Highway Structures
- National Assets, City Centers & Stadiums

We have the world’s broadest set of implementation choices for structural isolation.
LD Series and FVD Series
Ordering Information

Standard Material and Surface Finish

How to Order

Rod End:
Ball – Heat Treated Steel
Housing – Heat Treated Steel, Zinc Plated
Piston Rod: Chrome Plated Steel
Bearing: Bronze
Cylinder: Zinc plated steel
Cylinder End: Nickel Plated Steel

Special Materials Upon Request:
Rod End; Ball – Stainless Steel, Housing – Stainless Steel/Teflon Lined (PTFE); Nickel Plated Piston Rod;
Stainless Steel Cylinder; Piston Rod Protection: Bellows/Structural Sleeve

Ordering Example - LD Series

LD 7  20    B   -  4.0 -  V   -  100
Max velocity 100 cm/sec (Kine)
Damping Coefficient 4.0 kN-sec/m
Damping Configuration B
Linear Damper 700 Series
Total Stroke is 200mm

Ordering Example - FVD-B Series

FVD-B-1000-S-1200-α-0.4-V-1.00
Fmax, kN  Total Stroke, mm  α  Vmax, m/sec

Ordering Example - FVD-H Series

FVD-H-0500-S-0200-α-0.4-V-0.50
Fmax, kN  Total Stroke, mm  α  Vmax, m/sec