Springs
Plungers
Shock Absorbers
Track Tensioners

Advantage through Innovation

P.I.T.
Liquid Spring Technology
Compression and Tension Springs
Track Tensioning Devices
Dampening Elements

Preloads from
50 kg
to 500,000 kg
Energy Absorption
up to 1000 kJ

P.I.T. Federn GmbH, Schützenstr. 35, D - 58135 Hagen / Germany
Tel.: (49) 2331 - 463 547, Fax: (49) 2331 - 463 549, Email: info@pit-germany.de, URL: www.pit-germany.de
Mr. Petersmann has for many years been developing tensioning and damping devices on the basis of hydrostatic compression of liquid Elastomers.

Initially the idea was to find an alternative to the conventional heavy duty tensioning devices found on big crawler tracks, such as nitrogen or hydraulic track tensioners. Due to their compact size, P.I.T. Track Tensioners are now found on numerous types of chain driven vehicles.

Up to date more than 80,000 P.I.T. Track Tensioners have been installed as OEM parts.

As opposed to conventional compression springs, which develop their force through torsional strain, the P.I.T. Tensioning Units use the properties of a highly compressible liquid. The P.I.T. Spring operates by mechanically compressing Silicone Oil in a sealed chamber, the so called inner cylinder.

Fitted with an outer cylinder the P.I.T. Spring becomes a Track Tensioner with integrated grease chamber for pre tensioning of the chain.

The same principle applies to the P.I.T. Dampening Units (shock absorbers).

Here again the physical properties of the compressible liquid allow a very precise rate of deceleration. It is even possible to combine a spring and a damper, all in one element.

High forces and small installation dimensions are the outstanding characteristics of the P.I.T. Liquid Tensioning Elements. Force capacity ranges from 50 kg to over 500,000 kg per Element. Next to standard Elements, P.I.T. specializes in custom made Elements to meet your special requirements.
The P.I.T. elements mainly consist of a sealed cylinder filled with the compressible liquid. By mechanically compressing the liquid in a sealed Chamber, the element is able to absorb, or completely store and release all energy.

The basis of this technologie is the utilisation of a highly compressible silicone oil. The physical properties of the silicone oil allow the P.I.T. elements to be designed as an energy storage device (spring), as well as an energy transforming device (shock absorber).

The liquid silicone oil in the cylinder is initially under a predetermined pressure. Once the piston rod immerses in the cylinder (due to an external force), the silicone oil is compressed within the cylinder.

The internal pressure grows and attains its maximum when the piston rod is completely immersed. When the external force is released the stored energy pushes the piston rod back into its initial position. The element is again ready for use.

The piston rod is made out of 1.4021 rust-free stainless steel, is hardened and polished.

The piston bearing is made out of 42CrMo4V.

The inner cylinder (pressure cylinder) is one piece, machined from steel bar stock 42CrMo4V. The surface is hardened up to 65 HRc with the FER-N-OX® method. Additionally there is rust protection under the surface.

The outer cylinder is made out of St 52 and is rust protected.
The Liquid Spring Technology Product Range

- **PIT - Shock Absorber**
  - Adjustable Spring Force

- **PIT - Tension Spring**
  - Release with oil pressure

- **PIT - Track Tensioner**
  - With integrated Track Adjustment device

- **Hydraulik Buffer / Accumulator**
  - Relieves peak hydraulic pressures
  - Protects pumps, hoses, valves, gearboxes

- **PIT - Compression Spring**
  - Standard Element

- **PIT**
  - Tension and Compression Spring
  - Combined in one Unit
Here are some advantages of the P.I.T. systems:
- As compared to a conventional compression spring the elements are much smaller in size, while keeping the same forces.
- While keeping the same size, the P.I.T. elements can produce much higher forces than a conventional compression spring.
- P.I.T. elements allow a much longer spring excursion to a comparable conventional spring.
- P.I.T. can manufacture tensioning elements with a degressive spring rate. That means that the endload \( F_b \) is lower than the preload \( F_a \).
- Very high decelleration can be achieved on a very short excursion with the P.I.T. dampers.
- P.I.T. springs and shock absorbers can be repaired. A broken conventional steel spring cannot be repaired.
- P.I.T. grants a warranty on its Elements of 2000 hours of operation, or 2 years after delivery.
The size of a P.I.T. Track Tensioner is **79% smaller** than the size of a conventional tensioner including the grease chamber for pre adjustment of the chain.

In both cases the tensioning elements incorporate the same forces and the same excursion.

The steel compression spring has a wire thickness of 63 mm, 7 coils, the outer diameter is 290 mm (mD = 227 mm) and has a detended length of 593 mm. To achieve a preload $F_a$ of 18,000 kg the spring is tensioned by 68 mm. After 60 mm of excursion the maximum endload $F_b$ of 34,000 kg is attained.

Please compare the steel recoil spring with the P.I.T. spring element. Both have exactly the same characteristics.

P.I.T. also manufactures this same element with $F_a = 22,000$ kg and $F_b = 38,000$ kg. Or we extend the excursion by 15 mm to a total of 75 mm. The P.I.T. element then has a load from $F_a = 18,000$ kg to $F_b = 38,000$ kg.
P.I.T. spring elements are used to control, store or mitigate the energy induced by the motion of masses. They are applied in a variety of industrial markets such as the construction industry, mining, transport, railroad industry just to name a few.

P.I.T. elements can be designed as a **compression**, as well as **tension** spring.

P.I.T. has designed an element that combines a compression as well as a tension spring **all in one unit** !

P.I.T. springs combine high spring force and energy storage in a small package. P.I.T. has also developed springs which are compatible to existing disc springs. These springs can handle low forces, at high cycle rates, on very short excursions.

<table>
<thead>
<tr>
<th>Preload max in kg</th>
<th>Length in mm</th>
<th>Diam. in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) PIT 50         : 50,000</td>
<td>630</td>
<td>220</td>
</tr>
<tr>
<td>B) PIT 26-45      : 30,000</td>
<td>605</td>
<td>150</td>
</tr>
<tr>
<td>C) PIT 25         : 22,000</td>
<td>465</td>
<td>130</td>
</tr>
<tr>
<td>D) PIT 5.10       : 6,200</td>
<td>405</td>
<td>96</td>
</tr>
<tr>
<td>E) PIT 5.50       : 5,500</td>
<td>230</td>
<td>100</td>
</tr>
<tr>
<td>F) Recoil         : 18,000</td>
<td>525</td>
<td>290</td>
</tr>
<tr>
<td>G) Recoil         :</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
P.I.T. Dampers, Shock Absorbers, Buffers
with an Energy Absorption of up to 1000 kJ

P.I.T. Damping Elements store part of the energy and release this stored energy in a smooth and controlled manner.

With this technology, not only can you control the motion of a mass, but it is also possible to bring (push) this mass back into its original position.

The following characteristics of P.I.T. dampers and shock absorbers make the difference to conventional dampening elements:
- stored recoil forces for secure and smooth movement of masses back into their original position
- controlled, factory preset recoil damping
- precise damping characteristics due to low viscous, highly compressible fluid
- recoil and damping forces are variable without changing installation dimensions of the element
- on site variation of installation length due to integrated grease chamber (optional)
- can be fully regenerated

PIT Shock Absorber
Standard

PIT Shock Absorber
With variable pre tensioning forces
P.I.T. Track Tensioners come with integrated grease chamber for adjusting the slack of the chain. This feature guarantees the smallest installation size. Where a flat spring characteristic is needed, P.I.T. Track Tensioners are equipped with a friction control. This means smoother recoil action, and so less wear on all track components.

P.I.T. - Track Tensioners offer the following distinct advantages as opposed to conventional steel spring recoil devices:

- distinct cost advantage with tensioners as of a preload of 20,000 kg
- longer life of your track components due to smooth, damped recoil action
- small installation size (only 2/3 of conventional tensioners)
- absolutely maintenance free
- integrated grease chamber for slack compensation of worn chains
- simple installation on site
- interchangeable to already existing tensioners
- can be fully regenerated in a short time. Finally a tensioner that can be repaired like other undercarriage components. A broken steel recoil spring cannot be repaired.

These track tensioners have been in operation for about 15 years. They were installed in excavators operating under extremely difficult conditions in marshlands. Within a couple of weeks they will be regenerated and sent back to the customer for another 10 - 15 years of hard work.

Safety Factors

P.I.T. Track Tensioners are safe to use. The rapid and dramatic expansion which often causes severe accidents when handling worn steel springs or nitrogen tensioners does not occur with P.I.T. tensioners owing to the special physical properties of the Elastomer. A very important consideration with regard to product liability!
- The compressible medium (fluid silicone oil) \(1\) in the inner cylinder \(7\) is brought to a pre determined basic pressure (Preload \(F_a\)).
- This pressure acts on the surface of the piston \(2\).
- Due to external force the piston \(2\) immerses in the medium.
- The tensioner is at its maximum force (Endload \(F_b\)) when the piston is completely immersed (max. stroke \(3\)) in the medium.
- Once the external force is taken away the piston, due to the accumulated energy, returns again on its own to the detende position.
- Through the grease nipple \(4\) grease is pumped into the grease chamber \(5\). The incompressible grease forces the inner cylinder \(7\) out of the outer cylinder \(8\). This allows a pre-tensioning (adjustment) of the chain to the amount of the adjustment excursion \(6\).

All forces, excursions and dimensions can be chosen individually by the client.
A) Conventional Track Tensioner
Preload  : 18,000 kg
Endload  : 34,000 kg
Excursion: 60 mm
(These parameters cannot be changed)

B) P.I.T. Track Tensioners and their variability
Preload  : 18,000 kg
Endload  : 34,000 kg
Excursion: 60 mm
   OR
Preload  : 22,000 kg
Endload  : 38,000 kg
Excursion: 60 mm
   OR
Preload  : 18,000 kg
Endload  : 38,000 kg
Excursion: 75 mm

These different parameters (and any combination in between) are possible without changing the size or dimensions of the tensioner. This allows our clients to install one tensioner in a variety of different tracks.
Preloads from 50 kg to 500,000 kg

Compared with conventional steel spring/nitrogen track tensioners, P.I.T. tensioners offer the following distinct advantages:

- maintenance free
- compact installation
- integrated grease cylinder for chain pre adjustment
- low block tension when using "valve - controlled " System
- prolonged durability of all undercarriage components owing to smoother and delayed expansion of the tension system
- fully re-usable i.e. here at last is a tensioner that can be repaired and reconditioned like other track components, which of course has never been possible before with steel spring systems

<table>
<thead>
<tr>
<th>Type</th>
<th>PIT</th>
<th>A Length mm</th>
<th>B Diameter mm</th>
<th>C Excursion mm</th>
<th>Forces in kN</th>
<th>1 Preload</th>
<th>2 Endload</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIT 2 - 4</td>
<td>240</td>
<td>90</td>
<td>40</td>
<td>20</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIT 3 - 5</td>
<td>300</td>
<td>100</td>
<td>40</td>
<td>30</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIT 4</td>
<td>440</td>
<td>100</td>
<td>45</td>
<td>40</td>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIT 5,5</td>
<td>260</td>
<td>121</td>
<td>40</td>
<td>55</td>
<td>67</td>
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<tr>
<td>PIT 9</td>
<td>475</td>
<td>133</td>
<td>60</td>
<td>75</td>
<td>104</td>
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<tr>
<td>PIT 11</td>
<td>640</td>
<td>133</td>
<td>60</td>
<td>110</td>
<td>120</td>
<td></td>
<td></td>
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<tr>
<td>PIT 13</td>
<td>515</td>
<td>133</td>
<td>55</td>
<td>130</td>
<td>210</td>
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<tr>
<td>PIT 15</td>
<td>460</td>
<td>139</td>
<td>55</td>
<td>110</td>
<td>204</td>
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<tr>
<td>PIT 35-SO</td>
<td>690</td>
<td>220</td>
<td>110</td>
<td>170</td>
<td>170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIT 20</td>
<td>555</td>
<td>194</td>
<td>65</td>
<td>180</td>
<td>270</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIT 18-34</td>
<td>515</td>
<td>159</td>
<td>65</td>
<td>180</td>
<td>330</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIT 20(PC125)</td>
<td>555</td>
<td>194</td>
<td>65</td>
<td>180</td>
<td>360</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Type PIT** | **A Length mm** | **B Diameter mm** | **C Excursion mm** | **Forces in kN**
--- | --- | --- | --- | ---
| **Preloads from 20 tons to 65 tons** |  |  |  | 
| PIT 16 | 500 | 178 | 65 | 200 334
| PIT 22-37 | 515 | 159 | 65 | 220 380
| PIT 25 | 500 | 159 | 50 | 220 370
| PIT 26-45 | 650 | 178 | 70 | 260 450
| PIT 30-51 | 650 | 178 | 70 | 300 510
| PIT 30 | 650 | 194 | 70 | 300 380
| PIT 35 | 650 | 220 | 70 | 350 460
| PIT 42-68 | 650 | 220 | 70 | 420 680
| PIT 50 | 690 | 245 | 70 | 500 716
| PIT 65 | 1000 | 273 | 85 | 650 1075
| PIT 65L | 1250 | 273 | 85 | 650 895
| **Preloads from 75 tons to 500 tons** |  |  |  | 
| PIT 75 | 1100 | 292 | 85 | 750 950
| PIT 85 | 1000 | 355 | 100 | 850 1050
| PIT 100 | 1100 | 355 | 85 | 1000 1507
| PIT 120 | 1100 | 355 | 90 | 1200 1673
| PIT 135 | 1200 | 355 | 90 | 1350 1786
| PIT 150 | 1300 | 419 | 100 | 1500 2265
| PIT 200 | 1760 | 470 | 120 | 2000 3070
| PIT 500 | 1750 | 660 | 150 | 5000 7770

We manufacture Track Tensioners according to your specifications and special requirements.
The P.I.T. Safety Valve

reliably protects your track gear
all in one, both from overtensioning (pre adjustment)
and overstressing / overloading, all in one.

- is maintenance free
- protects from chain overload
- is factory pre-adjusted to your demand
- guarantees correct chain pre-tensioning / adjustment
- replaces on site, within minutes, your conventional grease nipple
- is compatible to all known conventional (steel spring/recoil) track tensioning (grease filling) devices

This valve is an important safety argument for your clients
The following pages show other industrial applications for the P.I.T. Liquid Spring Technology Elements.

Shock absorbing element to protect against dynamic axial loads.

Dampening of loaded goods within the confinement of a container. Successfully counteracts jolts and longitudinal movement.

Side Buffers on railroad carriages.

Ready to use dampening collar. Protects rotary drive from impact of falling drilling rods.
Shock absorber

P.I.T.

Hagen

Shock absorbing element for dampening jolts incurred on the King Pin of semitrailers

Jolt

Pre determined dampening stroke

Track Tensioners with integrated grease chamber for length readjustment
Steady compensation of material lengthening and shortening \( \Delta \ell \) while being heated and cooled down i.e. while sintering steel.

Side Buffers
Energy absorption up to 30 kJ
Tension Spring used as a claw / clamp to hold workpiece securely on the machine. Hydraulik pressure is only needed to release the clamping pressure. The holding force is always present.

P.I.T. Compression Spring to hold workpiece securely in a vice. The Spring is released with hydraulik pressure. During operation the holding force is always present. No external energy is needed!
P.I.T.
Liquid- Springs, Dampers, Shock Absorbers, Track Tensioners can be used as

- Springs for Lathes and Mills
- Catch Springs for Mining Trolleys
- Protection of Transmitions on Drilling Plants
- Buffers and Dampers for Rail mounted Vehicles
- Dampers to cushion Freight within a Container
- Tension- and Compression Springs for Pile Drivers
- Shock Absorbers and Springs for Heavy Machinery
- Constant Pressure Springs for Scrapers on Conveyor Belts
- Springs for Couplings, Suspension, Bumpers on Rail Cars
- Track Tensioners on Crawler mounted Vehicles
- Compression Springs for Sporting Equipment
- Shock Absorbers on Cable Driven Elevators
- Springs for Lifting and Lowering Ramps
- Corrective Springs for Conveyor Belts
- Plungers in Steel Mills
- Buffers for Crash Protection

P.I.T. Dampers absorbing highest energies

P.I.T. Springs on conveyor belts

P.I.T. Track Tensioners

for a smooth ride
To make you an offer for a P.I.T. Track Tensioner, free of charge, we need the following information:

Company: ______________________________  Contact Partner: ______________________________
Field of Business: ______________________________  Street: ______________________________
ZIP Code: __________________  City: __________________  Country: __________________
Tel. with prefix: ________  Fax: ________  Email: ________  URL: __________________

Machine - Type: ____________________________  Total weight (laden): Kg  Lbs
Track Chain Pitch: mm  inch

Shoe type:
- Flat
- 2 - 3 web
- 1 web
- Rubber

Main type of operating ground:
- Heavy soil, bog soil, fields
- Light soil, rubble, sand
- Solid ground, asphalt

Existing dimensions for tensioner:
- Length (max): cm  feet
- Max. Length at preload: mm  inch
- Max. Diameter: mm  inch

Preferred/needed forces (optional):
- Fa (Preload): Kg  Lbs
- Fb (Endload): Kg  Lbs
- s (Stroke): mm  inch

For an offer, free of charge, please copy and fax to:
P.I.T. Federn GmbH, Schützenstr. 35, D - 58135 Hagen, Tel.: (49) 2331 - 463 547; Fax: (49) 2331 - 463 549
To make you an offer for a P.I.T. Tension / Compression Spring, free of charge, we need the following information:

Company: ______________________________  Contact Partner: ______________________________
Field of Business: ______________________________  Street: ______________________________
ZIP Code: ___________________________  City: ___________________________  Country: ___________________________
Tel. with prefix: ___________  Fax: ___________  Email: ___________  URL: ___________________________

Please select type of P.I.T. Spring:

- Tension Spring
- Compression Spring
- Tension and Compression

Application of Spring:


Required Forces:

- Fa (Preload) ___________ Kg (mm inch)
- Fb (Endload) ___________ Kg (mm inch)
- s (Stroke) ___________ mm (inch)

Available Installation Space:

- Max. Length ___________ mm (inch)
- Max. Diameter ___________ mm (inch)

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To make you an offer for a P.I.T. Damper/Shock Absorber/Buffer, free of charge, we need the following information:

Company : ______________________________  Contact Partner : ______________________________
Field of Business : ______________________________  Street : ______________________________
ZIP Code : __________________ City : __________________ Country : __________________
Tel. with prefix : __________ Fax : _________ Email : _________ URL : __________________

Please select type of P.I.T. Damping Element:
- Buffer
- Damper
- Shock Absorber

Application of Element:

Please select type of P.I.T. Damping Element:

Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>m (Mass to be decelerated)</td>
<td>Kg</td>
<td>___________</td>
</tr>
<tr>
<td>v (Impact Velocity)</td>
<td>m/s</td>
<td>___________</td>
</tr>
<tr>
<td>s (Stroke / estimated)</td>
<td>mm</td>
<td>___________</td>
</tr>
<tr>
<td>a (g Load Requirements)</td>
<td>m/s²</td>
<td>___________</td>
</tr>
<tr>
<td>C (cycle rate)</td>
<td>cycles / h</td>
<td>___________</td>
</tr>
</tbody>
</table>

Available Installation Space:

Max. Length  ___________ mm  ___________ inch
Max. Diameter ___________ mm  ___________ inch
Max. Height   ___________ mm  ___________ inch

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This small brochure can only hint at the possibilities of the
P.I.T. Liquid
Springs, Dampers and Shock Absorbers

For any further details or information please contact us
info@pit-germany.de
or visit our web site
www.pit-germany.de

We are specialized in solving complicated problems.
Where others resign P.I.T. begins

We are flexible enough for individual solutions
as well as mass production on short notice

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