Shock Absorbers and Rate Controls

Solutions in Energy Absorption and Vibration Isolation.

ENIDINE
An SPX Company
Enidine: Solutions in Energy Absorption and Vibration Isolation.
Enidine is widely recognized as the preferred source for energy absorption and vibration isolation products.

**Greater productivity and less downtime.** For more than 30 years, customers have relied on Enidine products to help make their machinery and equipment perform quietly, safely and more efficiently at higher speeds. For original equipment manufacturers and aftermarket applications, Enidine offers a unique combination of product selection, engineering excellence and technical support to meet even the toughest energy absorption application requirements.

**Responsive global operations.** Enidine is a worldwide organization, with manufacturing facilities and headquarters in Orchard Park, New York, USA; Bad Bellingen, Germany; and Yokohama, Japan. Additional sales offices are located in California, Mexico and the United Kingdom.

**Highly trained distributors.** Each geographic region is supported by a well-established distributor network that shares our company’s commitment to customer service and quality. All Enidine distributors receive extensive training in identifying the best product for your application.

**Teamwork.** Working as a team, our global engineering, manufacturing, sales and distribution network allow for timely response to your needs with uncompromised excellence.

**Communication.** Our mission at Enidine has always been to be an industry leader in energy absorption and vibration isolation solutions. In carrying out that mission, we’ve made it paramount to communicate directly with our customers, distributors, representatives, and employees to better understand and respond to your needs. This ongoing interaction has helped make Enidine the growing, vibrant, global presence it is today.

**Custom solutions capabilities.** If you are unsure whether one of our standard products meets your requirements, feel free to speak with one of our technical representatives on +49 (0) 7635 8101 0, or contact us via e-mail at info@enidine.de.

Enidine engineers continue to monitor and influence trends in the motion control industry, allowing us to remain at the forefront of new energy absorption product development. Our experienced engineering team has designed custom solutions for a wide variety of challenging applications, including automated warehousing systems and shock absorbers for hostile industrial environments such as glass manufacturing, among others. These custom application solutions have proven to be critical to our customers’ success. Let Enidine engineers do the same for you.

For better performance and productivity, call your local Enidine representative.

**Enisize sizing software.**

- Adjustable Hydraulic Series
- Non-Adjustable Hydraulic Series
- Heavy Duty (HD/HDA) Series
- Heavy Industry (HI) Series
- Rate Controls

Each section describes the unique features and benefits of models within an associated product family, including envelope drawings, technical data charts, curves, detailed sizing instructions and application examples.

For immediate product sizing assistance, we also invite you to utilize our new multi-language, windows-based Enisize software, affixed to the back inside cover of this book. With a few simple steps, Enisize will allow you to quickly calculate, size and select the correct product, recommend proper accessories and facilitate ordering.

Regular updates of Enisize are available for download at www.enidine.de. When used in conjunction with our new Global Shock Absorber catalogue, these tools can serve as an instant resource to verify calculations, help properly size and order product, and most importantly – help take the guesswork out of shock absorber selection.
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<td>The OEM Hydraulic Series is the industry standard for general shock absorber applications. A wide range of energy capacities, sizes, mounting styles and other options are available.</td>
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<td><strong>Non-Adjustable Hydraulic Series Shock Absorbers</strong></td>
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<td>Non-Adjustable Hydraulic Series shock absorbers accommodate a wide range of energy conditions without adjustment. Higher energy capabilities are provided in a small overall envelope size. These fixed-orifice designs provide consistent performance with tamperproof reliability (see Product Locator, page 32), and are available with a variety of accessories (see pages 41-46).</td>
<td></td>
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<td><strong>TK Series</strong></td>
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<tr>
<td>Versatile, miniature hydraulic shock absorbers ideally suited for effective, reliable deceleration of light loads.</td>
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<td><strong>STH Series</strong></td>
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<td>Custom-orificed, compact hydraulic shock absorbers that absorb maximum energy for their size and weight.</td>
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<td><strong>PM Series</strong></td>
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<tr>
<td>Self-compensating, hydraulic shock absorbers that conveniently accommodate an extensive range of varying energy shock absorption applications, including low impact velocity and high drive force conditions, without requiring adjustment.</td>
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<td><strong>PRO Series</strong></td>
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<tr>
<td>Unique progressive damping hydraulic shock absorbers offer softer stops for medium-to-high impact velocity applications and conveniently accommodate varying energy conditions without adjustment.</td>
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The HD/HDA Shock Absorbers should be selected when the application involves heavy loads with high energy absorption requirements. Typical applications would include safety stops for overhead/stacker cranes, people movers and large material handling systems. These units, available in both adjustable and non-adjustable models, are capable of meeting OSHA, AISE, CMAA, DIN and ISO standards (see Product Locator, page 47).

**HD/HDA Series**
Large bore, heavy-duty adjustable and non-adjustable hydraulic models smoothly and safely decelerate large moving loads. An integral accumulator replaces a mechanical return spring, thus minimizing the unit’s length, weight and cost.

Enidine’s Heavy Industry (HI) Series buffers safely protect heavy machinery and equipment during the transfer of materials and movement of products. The large-bore, high-capacity buffers are individually designed to decelerate moving loads under various conditions and in compliance with industry mandated safety standards. Control of bridge cranes, trolley platforms, large container transfer and transportation safety stops are typical installations. Industry-proven design technologies, coupled with the experience of a globally installed product base, ensure deliverable performance that exceeds customer expectations.

**Rate Controls**
Hydraulic Rate Controls are used to control the velocity of a moving load through its entire linear or rotational motion. Adjustable and non-adjustable models are available in both double acting (compression/tension) and single acting (compression or tension) configurations. All units have hardened/plated piston rods, long-life seals and an extra-long bearing to assure reliability and durability (see Product Locator, page 67).

**ADA Series**
Adjustable double acting hydraulic series of dampers controls both linear and rotational (hinged) loads with unique interchangeable cartridges. Adjustable, fixed or free flow cartridges permit motion control flexibility in tension and/or compression modes.

**DA Series**
Double acting, custom orificed, hydraulic series of dampers are ideal for high energy applications requiring damping/rate control in tension, compression, or both.
Enidine has the widest selection of industrial shock absorber and rate control products in the industry. With nearly 450 standard products to choose from and limitless custom possibilities, our products decelerate velocity up to 18 m/sec and absorb energy between one and 1 million Nm. We constantly evaluate and refine our products to bring customers more features, greater performance and improved ease of use.

Enhancements to the small bore shock absorber series have provided softer/smoothier deceleration, integrated positive stop capabilities and improved durability, reliability and performance. Wrench flats on these shock absorbers make them easier to install.

Customers have many choices when it comes to components:

- Products can incorporate nickel plating or stainless steel surfaces for corrosive environments, continuous wash down or food preparation applications.
- Alternate fluids maintain consistent damping characteristics over high and low temperature conditions.
- Attachment accessories provide a wide range of options for mounting, including clevis mounting configurations and air/oil sequencing systems.
- Soft urethane piston caps reduce noise and extend product life in high-cycle applications.

A redesign of our PRO and PM series was the direct result of input from machine builders, who said they needed to control higher velocity and larger drive forces with a smaller shock absorber.

Above all, a solid commitment to quality and superior customer service are at the heart of our business. By maintaining precise quality systems, we ensure that products perform as specified. We’re so certain, we offer a lifetime warranty on workmanship and materials.
A talented engineering staff works to design and maintain the most efficient energy absorption product lines available today, using the latest engineering tools:

• Solid Modeling
• 3D CAD Drawings
• Finite Element Analysis
• Complete Product Testing Facility

New product designs get to market fast because they can be fully developed in virtual environments before a prototype is ever built. This saves time and lets us optimize the best solution using real performance criteria.

Custom designs are not an exception at Enidine, they are an integral part of our business. Should your requirements fit outside of our standard product range, Enidine engineers can assist in developing special finishes, components, hybrid technologies and new designs to ensure a “best-fit” product solution tailored to your exact specifications.

Global Service and Support

Enidine has significantly improved its customer response times through a number of critical initiatives:

• Conversion to single-piece flow cellular manufacturing, enabling us to produce custom and standard products faster and better, with higher quality and greater efficiency.
• Enhanced customer service presence at all of our global facilities—ensuring prompt responses when you need them.
• Regular, intensive training of our authorized distributor network, making them better able to serve you.
• Global operations in USA, Germany, Japan, UK and Mexico.
• Newly enhanced Enisize sizing software, with regular updates available at www.enidine.de, to simplify the selection process and help choose the best product solution for your application needs.
• A comprehensive, multi-language web site full of application ideas, technical data, and guidance on selecting the product that’s right for you. Our website also features a fully searchable distributor selector that can tell you the authorized distributor in your area for quick, localized service.

These capabilities and more are at your disposal at Enidine. Let us show you how we can be of service today.

Our global customer service and technical sales departments, located within each of Enidine’s worldwide facilities, provide prompt and knowledgeable answers to your questions about proper sizing, ordering, technical applications, and implementation of the best energy absorption product for your application. This highly trained and motivated multi-lingual team is your most direct and immediate interface with our company.
Overview of Energy Absorption Theory

As companies strive to increase productivity by operating machinery at higher speeds, often the results are increased noise, damage to machinery/products, and excessive vibration. At the same time, safety and machine reliability is decreased. A variety of products are commonly used to solve these problems. However, they vary greatly in effectiveness and operation. Typical products used include rubber bumpers, springs, cylinder cushions and shock absorbers. The following illustrations compare how the most common products perform:

All moving objects possess kinetic energy. The amount of energy is dependent upon weight and velocity. A mechanical device that produces forces diametrically opposed to the direction of motion must be used to bring a moving object to rest.

Rubber bumpers and springs, although very inexpensive, have an undesirable recoil effect. Most of the energy absorbed by these at impact is actually stored. This stored energy is returned to the load, producing rebound and the potential for damage to the load or machinery. Rubber bumpers and springs initially provide low resisting force which increases with the stroke.

Cylinder cushions are limited in their range of operation. Most often they are not capable of absorbing energy generated by the system. By design, cushions have a relatively short stroke and operate at low pressures resulting in very low energy absorption. The remaining energy is transferred to the system, causing shock loading and vibration.

Shock absorbers provide controlled, predictable deceleration. These products work by converting kinetic energy to thermal energy. More specifically, motion applied to the piston of a hydraulic shock absorber pressurizes the fluid and forces it to flow through restricting orifices, causing the fluid to heat rapidly. The thermal energy is then transferred to the cylinder body and harmlessly dissipated to the atmosphere.

The advantages of using shock absorbers include:

1. Longer Machine Life – The use of shock absorbers significantly reduces shock and vibration to machinery. This eliminates machinery damage, reduces downtime and maintenance costs, while increasing machine life.

2. Higher Operating Speeds – Machines can be operated at higher speeds because shock absorbers control or gently stop moving objects. Therefore, production rates can be increased.

3. Improved Production Quality – Harmful side effects of motion, such as noise, vibration and damaging impacts, are moderated or eliminated so the quality of production is improved. Therefore, tolerances and fits are easier to maintain.

4. Safer Machinery Operation – Shock absorbers protect machinery and equipment operators by offering predictable, reliable and controlled deceleration. They can also be designed to meet specified safety standards, when required.

5. Competitive Advantage – Machines become more valuable because of increased productivity, longer life, lower maintenance costs and safer operation.

Automotive vs. Industrial Shock Absorbers

It is important to understand the differences that exist between the standard automotive-style shock absorber and the industrial shock absorber. The automotive style employs the deflective beam and washer method of orificing. Industrial shock absorbers utilize single orifice, multi-orifice and metering pin configurations. The automotive type maintains a damping force which varies in direct proportion to the velocity of the piston, while the damping force in the industrial type varies in proportion to the square of the piston velocity. In addition, the damping force of the automotive type is independent of the stroke position while the damping force associated with the industrial type can be designed either dependent or independent of stroke position.
Equally as important, automotive-style shock absorbers are designed to absorb only a specific amount of input energy. This means that, for any given geometric size of automotive shock absorber, it will have a limited amount of absorption capability compared to the industrial type. This is explained by observing the structural design of the automotive type and the lower strength of materials commonly used. These materials can withstand the lower pressures commonly found in this type. The industrial counterpart of shock absorber uses higher strength materials, enabling it to function at higher damping forces.

Adjustment Techniques

A properly adjusted shock absorber safely dissipates energy, reducing damaging shock loads and noise levels. For optimum adjustment setting see useable adjustment setting graphs. Watching and "listening" to a shock absorber as it functions aids in proper adjustment.

To correctly adjust a shock absorber, set the adjustment knob at zero (0) prior to system engagement. Cycle the mechanism and observe deceleration of the system. If damping appears too soft (unit strokes with no visual deceleration and bangs at end of stroke), move indicator to next largest number. Adjustments must be made in gradual increments to avoid internal damage to the unit (e.g., adjust from 0 to 1, not 0 to 4).

Increase adjustment setting until smooth deceleration or control is achieved and negligible noise is heard when the system starts either to decelerate or comes to rest. When abrupt deceleration occurs at the beginning of the stroke (banging at impact), the adjustment setting must be moved to a lower number to allow smooth deceleration.

If the shock absorber adjustment knob is set at the high end of the adjustment scale and abrupt deceleration occurs at the end of the stroke, a larger unit may be required.

Shock Absorber Performance When Weight or Impact Velocity Vary

When conditions change from the original calculated data or actual input, a shock absorber’s performance can be greatly affected, causing failure or degradation of performance. Variations in input conditions after a shock absorber has been installed can cause internal damage, or at the very least, can result in unwanted damping performance. Variations in impact velocity can be seen by examining the following energy curves:

Varying Impact Weight: Increasing the impact weight (impact velocity remains unchanged), without reorificing or readjustment will result in increased damping force at the end of the stroke. Figure 1 depicts this undesirable bottoming peak force. This force is then transferred to the mounting structure and impacting load.

Varying Impact Velocity: Increasing impact velocity (weight remains the same) results in a radical change in the resultant shock force. Shock absorbers are velocity conscious products; therefore, the critical relationship to impact velocity must be carefully monitored. Figure 2 depicts the substantial change in shock force that occurs when the velocity is increased. Variations from original design data or errors in original data may cause damage to mounting structures and systems, or result in shock absorber failure if the shock force limits are exceeded.

<table>
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<tr>
<th>OFFICE AREA</th>
<th>Damping Force</th>
<th>Damping Force</th>
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<tr>
<td>TOO SMALL</td>
<td>TOO HIGH</td>
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<tr>
<td>(SHOCK FORCE)</td>
<td>(STROKE)</td>
<td>(SHOCK FORCE)</td>
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<td></td>
<td></td>
<td>(STROKE)</td>
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Figure 1

Figure 2
SHOCK ABSORBER SIZING

Follow the next six steps to manually size Enidine shock absorbers.

STEP 1: Identify the following parameters. These must be known for all energy absorption calculations. Variations or additional information may be required in some cases.

A) The weight of the load to be stopped (kg).
B) The velocity of the load upon impact with the shock absorber (m/sec).
C) External (propelling) forces acting on the load in (N), if any.
D) The cyclic frequency at which the shock absorber will operate.
E) Orientation of the application’s motion (i.e. horizontal, vertical up, vertical down, inclined, rotary horizontal, rotary vertical up, rotary vertical down).

NOTE: For rotary applications, it is necessary to determine the radius of gyration (K) and the mass moment of inertia (I). Both of these terms locate the mass of a rotating object with respect to the pivot point. It is also necessary to determine the angular velocity (ω) and the torque (T).

STEP 2: Calculate the kinetic energy of the moving object.

\[ E_k = \frac{1}{2} m v^2 \] (linear) or \[ E_k = \frac{1}{2} I \omega^2 \] (rotary)

Utilizing the Product Locator for Shock Absorbers located at the beginning of each product family section, select a model, either adjustable or non-adjustable, with a greater energy per cycle capacity than the value just calculated.

STEP 3: Calculate the work energy input from any external (propelling) forces acting on the load, using the stroke of the model selected in Step 2.

\[ E_w = F_s \times S \] (linear) or \[ E_w = F_s \times S \] (rotary)

Caution: The propelling force must not exceed the maximum propelling force listed for the model chosen. If the propelling force is too high, select a larger model and recalculate the work energy.

STEP 4: Calculate the total energy per cycle.

\[ E_T = E_k + E_w \]

The model selected must have at least this much energy capacity. If not, select a model with a greater energy capacity and return to Step 3.

STEP 5: Calculate the energy that must be absorbed per hour. Even though the shock absorber can absorb the energy in a single impact, it may not be able to dissipate the heat generated if the cycle rate is too high.

\[ E_C = E_T \times C \]

The model selected must have an energy per hour capacity greater than this. If it is not greater, there are two options:

1. Choose another model that has more energy per hour capacity (because of larger diameter or stroke). Keep in mind that if the stroke changes, you must return to Step 3.
2. Use an Air/Oil Tank. The increased surface area of the tank and piping will increase the energy per hour capacity by 20 percent.

STEP 6: If you have selected an adjustable model (OEA, HP or HDA series), refer to the Useable Adjustment Setting Range graph for the chosen model. The impact velocity must fall within the limits shown on the graph.

RATE CONTROL SIZING

Follow the next five steps to manually size Enidine rate controls:

STEP 1: Identify the following parameters. These must be known for all rate control calculations. Variations or additional information may be required in some cases.

A) The weight of the load to be controlled (kg).
B) The desired velocity of the load (m/sec).
C) External (propelling) force acting on the load in (N), if any.
D) The cyclic frequency at which the rate control will operate.
E) Orientation of the application’s motion (i.e. horizontal, vertical up, vertical down, inclined, rotary horizontal, rotary vertical up, rotary vertical down).

NOTE: For rotary applications, please submit the application worksheet on page 11 to Enidine for sizing.

STEP 2: Calculate the propelling force at the rate control in each direction damping is required. (See sizing examples on page 10.)

CAUTION: The propelling force in each direction must not exceed the maximum propelling force listed for the chosen model. If the propelling force is too high, select a larger model.

STEP 3: Calculate the total energy per cycle.

\[ E_T = E_{W(t)} + E_{W(c)} \]

where \( E_{W(t)} \) is the tension energy and \( E_{W(c)} \) is the compression energy.

STEP 4: Calculate the total energy per hour.

\[ E_{T,C} = E_T \times C \]

The model selected must have an energy per hour capacity greater than this. If not, choose a model with a higher energy per hour capacity.

STEP 5: Compare the damping direction, stroke, propelling force, and total energy per hour to the values listed in the Rate Controls Engineering Data Charts (pages 71-76).

If you have selected a rate control, refer to the sizing graphs in the Rate Controls section to determine the required damping constant.

If you have selected an adjustable model (ADA), refer to the Useable Adjustment Setting Range graph for the chosen model. The desired velocity must fall within the limits shown on the graph.
SYMBOLS

α = Angle of incline (degrees)
β = Start point from true vertical
θ = Angle of rotation (degrees)
ω = Angular velocity (radians/sec)

USEFUL FORMULAS

1. To Determine Shock Force

FP = \[ \frac{9.8 \times W \times \cos \beta}{0.0785 \times s} \] for PRO and PM Series only, use FP = \[ \frac{7.07 \times 0.50}{s} \]

2. To Determine Impact Velocity

A. If there is no acceleration (V is constant), for example: load being pushed by hydraulic cylinder or motor driven.

V = \[ \sqrt{2 \times \left( \frac{E_K}{W} \right)} \]

B. If there is acceleration, for example: load being pushed by air cylinder

V = \[ \sqrt{2 \times 0.0785 \times \left( \frac{E_K}{W} \right) + a \times \frac{S}{t}} \]

3. To Determine Propelling Force Generated by Electric Motor

FP = \[ \frac{3.000 \times E_W}{d^2 \times P} \]

4. To Determine Propelling Force of Pneumatic or Hydraulic Cylinders

FP = \[ \frac{0.0785 \times d^2 \times P}{0.0785 \times s} \]

5. Free Fall Applications

A. Find Velocity for a Free Falling Weight:

V = \[ \sqrt{2 \times \left( \frac{E_T}{W} \right)} \]

B. Kinetic Energy of Free Falling Weight:

E_K = \[ \frac{9.8 \times W \times H}{0.50} \] or \[ \frac{9.8 \times W \times H}{0.85} \]

6. Deceleration

A. To determine approximate deceleration load with a given stroke (conventional damping only)

a = \[ \frac{FP - FD}{W} \]

B. To determine the approximate stroke with a deceleration load (conventional damping only)

\[ \frac{FP - FD}{W} \times 0.50 \times \frac{S}{t} \]

NOTE: Constants (0.5/0.85/19.6) are printed in bold.

STEP 1: Application Data

(W) Weight = 1550 kg
(H) Height = 0.5 m
(D) Cylinder bore dia. = 100mm
(C) Cycles/hr = 200

STEP 2: Calculate kinetic energy

E_K = \[ \frac{9.8 \times W \times H}{0.50} \]

STEP 3: Calculate work energy

E_W = \[ \frac{9.8 \times W \times H}{0.50} \] or \[ \frac{9.8 \times W \times H}{0.85} \]

STEP 4: Calculate total energy per cycle

E_T = \[ E_W + \frac{9.8 \times W \times H}{0.50} \]

STEP 5: Calculate total energy per hour

E_T \times C = \[ \frac{9.8 \times W \times H}{0.50} \times 2 \]

STEP 6: Calculate impact velocity and confirm selection

V = \[ \sqrt{2 \times \left( \frac{E_T}{W} \right)} \]

W \times a \times 0.50 \times \frac{S}{t} = \[ \frac{9.8 \times W \times H}{0.50} \] or \[ \frac{9.8 \times W \times H}{0.85} \]

Model O 材 4.0M x 4 is adequate for this application.

STEP 1: Application Data

(W) Weight = 1550 kg
(V) Velocity = 2.0 m/sec
(D) Cylinder bore dia. = 150mm
(P) Operating pressure = 5 bar
(C) Cycles/hr = 200

STEP 2: Calculate kinetic energy

E_K = \[ \frac{9.8 \times W \times V^2}{2} \] or \[ \frac{9.8 \times W \times V^2}{2.0} \]

STEP 3: Calculate work energy

E_W = \[ \frac{9.8 \times W \times V^2}{2} \] or \[ \frac{9.8 \times W \times V^2}{2.0} \]

STEP 4: Calculate total energy per cycle

E_T = \[ E_W + \frac{9.8 \times W \times V^2}{2} \]

STEP 5: Calculate total energy per hour

E_T \times C = \[ \frac{9.8 \times W \times V^2}{2} \times 2 \]

STEP 6: Calculate impact velocity and confirm selection

V = \[ \sqrt{2 \times \left( \frac{E_T}{W} \right)} \]

W \times a \times 0.50 \times \frac{S}{t} = \[ \frac{9.8 \times W \times V^2}{2} \] or \[ \frac{9.8 \times W \times V^2}{2.0} \]

Model O 材 4.0M x 4 is adequate.
Sizing Examples

**EXAMPLE 4:**
Vertical Moving Load with Propelling Force from Motor

**STEP 1:** Application Data
- (W) Weight = 90 kg
- (V) Velocity = 1.5 m/sec
- (kW) Motor rating = 1 kW
- (C) Cycles/Hr = 100

**STEP 2:** Calculate kinetic energy
\[ E_k = \frac{W}{2} \times V^2 \]
- \( E_k = 101 \text{ Nm} \)

**CASE A: UP**

**STEP 3:** Calculate work energy
\[ F_d = \frac{3.000 \times kW}{V} \]
- \( F_d = \frac{3.000 \times 1}{1.5} \)
- \( F_d = 1.118 \text{ N} \)

**STEP 4:** Calculate total energy per cycle
\[ E_t = E_k + E_w \]
- \( E_t = 1.118 + 56 \)
- \( E_t = 157 \text{ Nm/cycle} \)

**STEP 5:** Calculate total energy per hour
\[ E_{th} = E_t \times C \]
- \( E_{th} = 157 \times 100 \)
- \( E_{th} = 15700 \text{ Nm/hr} \)

Model OEM 1.25M x 2 is adequate.

**EXAMPLE 5:**
Horizontal Moving Load

**STEP 1:** Application Data
- (W) Weight = 90 kg
- (V) Velocity = 1.5 m/sec
- (kW) Motor rating = 1 kW
- (C) Cycles/Hr = 100

**STEP 2:** Calculate kinetic energy
\[ E_k = \frac{W}{2} \times V^2 \]
- \( E_k = 101 \text{ Nm} \)

**STEP 3:** Calculate work energy
\[ F_d = \frac{3.000 \times kW}{V} \]
- \( F_d = \frac{3.000 \times 1}{1.5} \)
- \( F_d = 1.118 \text{ N} \)

**STEP 4:** Calculate total energy per cycle
\[ E_t = E_k + E_w \]
- \( E_t = 101 + 56 \)
- \( E_t = 157 \text{ Nm/cycle} \)

**STEP 5:** Calculate total energy per hour
\[ E_{th} = E_t \times C \]
- \( E_{th} = 157 \times 100 \)
- \( E_{th} = 15700 \text{ Nm/hr} \)

Model OEM 1.25M x 2 is adequate.

**EXAMPLE 6:**
Horizontal Moving Load with Propelling Force

**STEP 1:** Application Data
- (W) Weight = 1000 kg
- (V) Velocity = 1.5 m/sec
- (kW) Motor rating = 1 kW
- (C) Cycles/Hr = 120

**STEP 2:** Calculate kinetic energy
\[ E_k = \frac{W}{2} \times V^2 \]
- \( E_k = 1025.5 \text{ Nm} \)

**STEP 3:** Calculate work energy
\[ F_d = \frac{3.000 \times kW}{V} \]
- \( F_d = \frac{3.000 \times 1}{1.5} \)
- \( F_d = 2000 \text{ N} \)

**STEP 4:** Calculate total energy per cycle
\[ E_t = E_k + E_w \]
- \( E_t = 1025.5 + 2000 \)
- \( E_t = 3025.5 \text{ Nm/cycle} \)

**STEP 5:** Calculate total energy per hour
\[ E_{th} = E_t \times C \]
- \( E_{th} = 3025.5 \times 120 \)
- \( E_{th} = 363060 \text{ Nm/hr} \)

Model OEM 2.0M x 2 is adequate.
Sizing Examples

EXAMPLE 8:  Horizontal Moving Load
Propelled by Drive Rollers
(Chain/Belt Drive or Conveyor Belt)

STEP 1: Application Data
(W) Weight = 800 kg
(V) Velocity = 1.2 m/sec
(µ) Coefficient of Friction = 0.3
(C) Cycles/Hr = 120

STEP 2: Calculate kinetic energy
Ek = \frac{W}{2} x V^2
Ek = \frac{800}{2} x 1.2^2
Ek = 576 Nm
Assume Model PM 2050M is adequate (Page 37).

STEP 3: Calculate work energy
Fd = \frac{9.8 x W x \mu}{2}
Fd = \frac{9.8 x 800 x 0.3}{2}
Fd = 2,352 N
Ew = \frac{F_d x S}{2}
Ew = \frac{2,352 x 0.05}{2}
Ew = 117.6 Nm

STEP 4: Calculate total energy per cycle
E_t = E_k + E_w
E_t = 576 + 117.6
E_t = 693.6 Nm

STEP 5: Calculate total energy per hour
E_{tc} = E_t x C
E_{tc} = 693.6 x 120
E_{tc} = 83,232 Nm/hr
From PM sizing graph, Model PM 2050M is adequate.

EXAMPLE 9: Free Moving Load
Down an Inclined Plane

STEP 1: Application Data
(W) Weight = 250 kg
(H) Height = 0.2 m
(α) Angle of incline = 30˚
(C) Cycles/Hr = 250

STEP 2: Calculate kinetic energy
Ek = \frac{W x H \times \sin \alpha}{2}
Ek = \frac{9.8 x 250 x 0.2 \times \sin 30˚}{2}
Ek = 490 Nm
Assume Model OEM 1.5M x 3 is adequate (Page 21).

STEP 3: Calculate work energy
Fd = \frac{9.8 x W x \sin \alpha}{2}
Fd = \frac{9.8 x 250 x 0.5}{2}
Fd = 1225 N
Ew = \frac{F_d x S}{2}
Ew = \frac{1225 x 0.075}{2}
Ew = 91.9 Nm

STEP 4: Calculate total energy per cycle
E_t = E_k + E_w
E_t = 490 + 91.9
E_t = 581.9 Nm/c

STEP 5: Calculate total energy per hour
E_{tc} = E_t x C
E_{tc} = 581.9 x 250
E_{tc} = 145,475 Nm/hr

Model OEM 1.5M x 3 is adequate.

EXAMPLE 10: Horizontal Rotating Mass

STEP 1: Application Data
(W) Weight = 90 kg
(ω) Angular velocity = 1.5 rad/sec
(T) Torque = 120 Nm
(K) Radius of gyration = 0.4 m
(RS) Mounting radius = 0.5 m
(C) Cycles/Hr = 120

STEP 2: Calculate kinetic energy
I = \frac{W x K^2}{2}
I = \frac{90 x 0.4^2}{2}
I = 8.4 kgm^2
Ek = \frac{I x \omega^2}{2}
Ek = \frac{8.4 x 2.5^2}{2}
Ek = 26.3 Nm
Assume Model STH .5M is adequate (Page 34).

STEP 3: Calculate work energy
F_k = \frac{T X R_s}{2}
F_k = \frac{120 x 0.5}{2}
F_k = 30 N
Ew = \frac{F_k x S}{2}
Ew = \frac{30 x 0.013}{2}
Ew = 0.3 Nm

STEP 4: Calculate total energy per cycle
E_t = E_k + E_w
E_t = 26.3 + 0.3
E_t = 26.6 Nm/c

STEP 5: Calculate total energy per hour
E_{tc} = E_t x C
E_{tc} = 26.6 x 120
E_{tc} = 3,192 Nm/hr
Model STH .5M is adequate.

EXAMPLE 11: Horizontal Rotating Door

STEP 1: Application Data
(W) Weight = 25 kg
(ω) Angular velocity = 2.5 rad/sec
(RS) Mounting radius = 0.5 m
(A) Width = 1.0 m
(B) Thickness = 0.1 m
(C) Cycles/Hr = 250

STEP 2: Calculate kinetic energy
K = \frac{0.289 x 1.4 x 1.0 x 0.1^2}{2}
K = 0.058 m
I = 8.4 kgm^2
Ek = \frac{I x \omega^2}{2}
Ek = \frac{8.4 x 2.5^2}{2}
Ek = 26.3 Nm

STEP 3: Calculate work energy
F_k = \frac{T X R_s}{2}
F_k = \frac{20 x 0.5}{2}
F_k = 5 N
Ew = \frac{F_k x S}{2}
Ew = \frac{5 x 0.025}{2}
Ew = 0.5 Nm

STEP 4: Calculate total energy per cycle
E_t = E_k + E_w
E_t = 26.3 + 0.5
E_t = 26.8 Nm/c

STEP 5: Calculate total energy per hour
E_{tc} = E_t x C
E_{tc} = 26.8 x 250
E_{tc} = 6,700 Nm/hr
Model STH .5M is adequate.
**EXAMPLE 12:** Horizontal Moving Load, Rotary Table Motor Driven with Additional Load Installed

**STEP 1: Application Data**
- (W) Weight = 200 kg
- (W1) Installed load = 50 kg
- (T) Torque = 250 N·m
- (K) Radius of gyration = 0.2 m
- (R) Mounting radius = 0.225 m
- (C) Cycles/Hr = 1

**STEP 2: Calculate kinetic energy**
- (I) Moment of inertia = 10 x 0.289 = 2.89 kg·m²
- (E) Work energy = 245 x 0.35² = 48.7 Nm
- (C) Total energy per cycle = 184 Nm

**EXAMPLE 13:** Vertical Motor Driven Rotating Arm with Attached Load

**STEP 1: Application Data**
- (W) Weight = 245 kg
- (K) Angular velocity = 3.5 rad/sec
- (R) Mounting radius = 0.06 m
- (C) Cycles/Hr = 1

**STEP 2: Calculate kinetic energy**
- (I) Moment of inertia = 18 kg·m²

**EXAMPLE 14:** Vertical Rotating Beam

**STEP 1: Application Data**
- (W) Weight = 245 kg
- (K) Angular velocity = 3.5 rad/sec
- (R) Mounting radius = 0.06 m
- (C) Cycles/Hr = 1

**STEP 2: Calculate kinetic energy**
- (I) Moment of inertia = 18 kg·m²

**Sizing Examples**

**EXAMPLE A–Load Opposing Gravity**

**STEP 2: Calculate kinetic energy**
- (I) Moment of inertia = 184 Nm²

**EXAMPLE B–Load Aided by Gravity**

**STEP 2: Calculate kinetic energy**
- (I) Moment of inertia = 1242.5 Nm²

**CASE A**

**STEP 3: Calculate work energy**
- (F) Force = 350 N
- (R) Modifying radius = 0.225 m
- (C) Cycles/Hr = 1

**CASE B**

**STEP 3: Calculate work energy**
- (F) Force = 1242.5 N
- (R) Modifying radius = 0.225 m
- (C) Cycles/Hr = 1

**STEP 4: Calculate total energy per cycle**
- (E) Energy = 244.4 Nm

**STEP 5: Calculate total energy per hour**
- (E) Energy = 1111.1 Nm/c

**STEP 6: Calculate impact velocity and confirm selection**
- (V) Velocity = 0.24 m/sec

**STEP 7: Calculate impact velocity and confirm selection**
- (V) Velocity = 0.5 m/sec

**Model PM 1.0M is adequate.**

**Model PM 1.0M is adequate.**

From PM Sizing Graph, Model PM 1.0M is adequate.
**STEP 1: Application Data**

(W) Weight = 910 kg  
(Ω) Angular velocity = 2 rad/sec  
(kW) Motor rating = 0.20 kW  
(θ) Starting point from true vertical = 30°  
(Ø) Angle of rotation = 60°  
(RS) Mounting radius = 0.8 m  
(A) Width = 1.5 m  
(B) Thickness = 0.03 m  
(C) Cycle/Hr = 1

**STEP 2: Calculate kinetic energy**

\[ K = 0.289 \times \sqrt{4 \times 1.5^2 + 0.03^2} \]

\[ K = 0.289 \times \sqrt{4 \times 1.502 + 0.032} \]

\[ K = 0.87 \text{ m} \]

**STEP 3: Calculate work energy**

\[ I = W \times K^2 = 910 \times 0.87^2 \]

\[ I = 688.8 \text{ kgm}^2 \]

\[ E_K = I \times \omega^2 = 688.8 \times 2^2 \]

\[ E_K = 1377.6 \text{ Nm} \]

Assume Model OEM 3.0M x 2 is adequate (Page 21).

**STEP 4: Calculate total energy per cycle**

\[ E_1 = E_K + E_2 \]

\[ E_1 = 1377.6 + 503.7 \]

\[ E_1 = 1881.3 \text{ Nm} \]

**STEP 5: Calculate total energy per hour**

\[ ETC = E_1 \times C \]

\[ ETC = 1881.3 \times 200 \]

\[ ETC = 376260 \text{ Nm/hr} \]

Model OEM 3.0M x 2 is adequate.

---

**STEP 1: Application Data**

(W) Weight = 25 kg  
(D) Damping direction (T, C, or T and C) = T and C  
(S) Stroke = 0.1 m  
(d) Cylinder bore dia. = 50mm  
(d1) Cylinder rod dia. = 13mm  
(P) Pressure = 5 bar  
(V) Velocity = 0.15 m/sec  
(C) Cycles/Hr = 200

**STEP 2: Calculate propelling force**

\[ F_D = 0.0785 \times d^2 \times P \]

\[ F_D = 0.0785 \times 50^2 \times 5 \]

\[ F_D = 981.5 \text{ N} \]

\[ F_D = 0.0785 \times (d^2 - d_1^2) \times P \]

\[ F_D = 1324 \text{ N} \]

**STEP 3: Calculate total energy per cycle**

\[ E_W = F_D \times S \]

\[ E_W = 981.5 \times 0.1 \]

\[ E_W = 98.15 \text{ Nm/c} \]

\[ E_T = E_W \times F_D \]

\[ E_T = 98.15 \times 981.5 \]

\[ E_T = 96.41 \text{ Nm} \]

**STEP 4: Calculate total energy per hour**

\[ ETC = E_T \times C \]

\[ ETC = 96.41 \times 200 \]

\[ ETC = 19280 \text{ Nm/hr} \]

Model ADA 510M TC is selected.

---

**STEP 1: Application Data**

(W) Weight = 45 kg  
(D) Damping direction (T, C, or T and C) = T  
(S) Stroke = 0.1 m  
(P) Pressure = 4.5 bar  
(V) Velocity = 0.15 m/sec  
(C) Cycles/Hr = 10

**STEP 2: Calculate propelling force**

\[ F_D = 0.0785 \times d^2 \times P \]

\[ F_D = 0.0785 \times 50^2 \times 4.5 \]

\[ F_D = 9.85 \times 4.5 \]

\[ F_D = 340.4 \text{ N} \]

**STEP 3: Calculate total energy per cycle**

\[ E_W = F_D \times S \]

\[ E_W = 9.85 \times 0.1 \]

\[ E_W = 98.5 \text{ Nm/c} \]

\[ E_T = E_W \times F_D \]

\[ E_T = 98.5 \times 9.85 \]

\[ E_T = 964.1 \text{ Nm} \]

**STEP 4: Calculate total energy per hour**

\[ ETC = E_T \times C \]

\[ ETC = 964.1 \times 10 \]

\[ ETC = 9641 \text{ Nm/hr} \]

Model ADA 510M TP is selected.

---

**Sizing Examples**

**EXAMPLE 15:** Vertical Rotating Lid

**EXAMPLE 16:** Horizontal Moving Load with Propelling Force

**EXAMPLE 17:** Vertical Moving Load with Propelling Force Downward

---

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## Typical Crane Application Sizing Examples

### EXAMPLE 18:

#### Crane A

<table>
<thead>
<tr>
<th>Per Buffer</th>
<th>Propelling Force Crane</th>
<th>kN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Propelling Force Trolley</td>
<td>kN</td>
</tr>
<tr>
<td></td>
<td>Weight of Crane</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>Weight of Trolley</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>Distance X&lt;sub&gt;min&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Distance X&lt;sub&gt;max&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Distance Y&lt;sub&gt;min&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Distance Y&lt;sub&gt;max&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Crane Velocity</td>
<td>m/sec</td>
</tr>
<tr>
<td></td>
<td>Trolley Velocity</td>
<td>m/sec</td>
</tr>
</tbody>
</table>

#### Crane B

<table>
<thead>
<tr>
<th>Per Buffer</th>
<th>Propelling Force Crane</th>
<th>kN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Propelling Force Trolley</td>
<td>kN</td>
</tr>
<tr>
<td></td>
<td>Weight of Crane</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>Weight of Trolley</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>Distance X&lt;sub&gt;min&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Distance X&lt;sub&gt;max&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Distance Y&lt;sub&gt;min&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Distance Y&lt;sub&gt;max&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Crane Velocity</td>
<td>m/sec</td>
</tr>
<tr>
<td></td>
<td>Trolley Velocity</td>
<td>m/sec</td>
</tr>
</tbody>
</table>

#### Crane C

<table>
<thead>
<tr>
<th>Per Buffer</th>
<th>Propelling Force Crane</th>
<th>kN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Propelling Force Trolley</td>
<td>kN</td>
</tr>
<tr>
<td></td>
<td>Weight of Crane</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>Weight of Trolley</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>Distance X&lt;sub&gt;min&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Distance X&lt;sub&gt;max&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Distance Y&lt;sub&gt;min&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Distance Y&lt;sub&gt;max&lt;/sub&gt;</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>Crane Velocity</td>
<td>m/sec</td>
</tr>
<tr>
<td></td>
<td>Trolley Velocity</td>
<td>m/sec</td>
</tr>
</tbody>
</table>

### Please note:

Unless instructed otherwise, Enidine will always calculate with:

- 100% velocity \( v \), and
- 100% propelling force \( F_D \),

### Application 1

**Crane A against Solid Stop**

Velocity:

\[ V_r = V_A \]

Impact weight per buffer:

\[ W_D = \frac{W}{2} \]

**Application 2**

**Crane A against Crane B**

Velocity:

\[ V_r = V_A + V_B \]

Impact weight per buffer:

\[ W_D = \sqrt{W_A^2 + W_B^2} \]

**Application 3**

**Crane B against Crane C**

Velocity:

\[ V_r = V_B + V_C \]

Impact weight per buffer:

\[ W_D = \sqrt{W_B^2 + W_C^2} \]

**Application 4**

**Crane C against Solid Stop with Buffer**

Velocity:

\[ V_r = \frac{V_C}{2} \]

Impact weight per buffer:

\[ W_D = \frac{W_C}{2} \]
### Typical Crane Application Sizing Examples

Please note that this example is not based on any particular standard. The slung load can swing freely, and is therefore not taken into account in the calculation.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Weight of Crane</td>
<td>380 t</td>
</tr>
<tr>
<td>Weight of Trolley</td>
<td>45 t</td>
</tr>
<tr>
<td>Span</td>
<td>x = 100 m</td>
</tr>
<tr>
<td>Trolley Impact Distance</td>
<td>x = 90 m</td>
</tr>
<tr>
<td>Crane Velocity</td>
<td>( V_{Crane} = 90 \text{ m/min} = 1.5 \text{ m/s} )</td>
</tr>
<tr>
<td>Required Stroke</td>
<td>600 mm</td>
</tr>
<tr>
<td>Trolley Velocity</td>
<td>( V_{Trolley} = 240 \text{ m/min} = 4.0 \text{ m/s} )</td>
</tr>
<tr>
<td>Required Stroke</td>
<td>1000 mm</td>
</tr>
<tr>
<td>Bridge Weight per Rail</td>
<td>( \frac{380 \text{ t} - 45 \text{ t}}{2} = 167.5 \text{ t} )</td>
</tr>
<tr>
<td>WD(_{\text{max}}) = Bridge Weight per Rail + Trolley Weight in Impact Position</td>
<td>( 167.5 \text{ t} + \frac{(45 \text{ t} \times 90 \text{ m})}{100 \text{ m}} )</td>
</tr>
<tr>
<td>WD(_{\text{max}}) = 208 t</td>
<td></td>
</tr>
<tr>
<td>E(<em>K) = WD(</em>{\text{max}}) \times V(_r)^2</td>
<td>( E(_K) = 208 \text{ t} \times (1.5 \text{ m/s})^2 )</td>
</tr>
<tr>
<td>Selecting for required 600mm stroke:</td>
<td>HD 5.0 x 24, maximum shock force ca. 460 kN = ( F(_s) = \frac{E(_K)}{\eta} )</td>
</tr>
<tr>
<td>WD = Trolley Weight per Shock Absorber</td>
<td>45 t / 2 = 22.5 t</td>
</tr>
<tr>
<td>E(_K) = WD \times V(_r)^2</td>
<td>( E(_K) = 22.5 \text{ t} \times (4 \text{ m/s})^2 )</td>
</tr>
<tr>
<td>Selecting for required 1000mm stroke:</td>
<td>HD 4.0 x 40, maximum shock force ca. 212 kN = ( F(_s) = \frac{E(_K)}{\eta} )</td>
</tr>
</tbody>
</table>

**Calculation Example for Harbor Cranes as Application 1**

**Given Values**

**Determination of the Maximum Impact Weight WD\(_{\text{max}}\) per Buffer**

**Determine Size of Shock Absorber for Crane**

**Determine Size of Shock Absorber for Trolley**

\( V\(_r\) = V\(_r\) \text{ Application 1} \)

\( E\(_K\) = \text{Kinetic Energy} \)

\( \eta = \text{Efficiency} \)
To Ensure Correct Sizing:
If shock absorbers are used at less than 5% of their maximum rated energy per cycle (less than 10% for HDA and HP Series models), a smaller shock absorber should be used. If the shock absorber continually bottoms, verify sizing data.

Provide a Positive Stop
Stop collars provide a positive stop to prevent the shock absorber from bottoming*. They also ensure that work being positioned is stopped at the same point every time. Proper stop collar mounting is as follows:

A. OEM Small, HP Series stop collars should be positioned to leave 1.6mm of clearance before bottoming the shock absorber.

Platinum PRO and PM Series models have positive stop capabilities. However, the use of an external positive stop is recommended to extend the life of the product.

B. OEM Large Series – Stop collars for OEM 1.5M through OEM 2.0M and the low profile series thread onto the shock absorber and against the center shoulder or “boss.”

C. OEM Low Profile Series stop collar flange (SCF) serves both as a stop collar and mounting method. To install, mount SCF onto machine structure. Thread shock absorber into SCF through mounting structure until tight. Tighten set screw in flange of SCF. Check for accessibility of adjustment knob. Reorient assembly as required. Even if shock absorber is removed for maintenance, SCF maintains positive positioning and allows continued machinery operation at reduced speeds.

*Stop collars are not necessary if positive stop in mechanism already exists.

Items to Keep in Mind:
- Do not clamp, paint or weld the shock absorber body.
- Do not paint or damage the surface finish of the piston rod.

Flanges with Lock Slots
Flanges with lock slots, exclusively designed by Enidine, will hold the shock absorber body securely in place by applying pressure to cylinder body threads. To remove or reposition the unit, only the slotted flange bolt needs to be loosened. DO NOT REMOVE the shock absorber before this bolt is loosened. Verify that the bolt is tightened once the shock absorber is properly positioned.
To Correctly Adjust Shock Absorber:

To achieve the optimum adjustment setting:
1. Mount the shock absorber.
2. Set adjustment at zero (0)*
   Cycle mechanism; if too soft, turn adjustment to next largest number. Repeat procedure until desired damping force is obtained.
3. Lock adjustment by tightening set screw with hex key wrench provided.

CAUTION:
A. Internal damage can occur if not adjusted in gradual increments.
B. If adjustment is set to the largest number and the mechanism is bottoming too hard at the end of the stroke, a larger unit is required.
C. If adjustment setting is set to the lowest number “0” and the mechanism is hitting too hard at the beginning of the stroke, a smaller unit is required.

*For the approximate adjustment setting to be used, consult Useable Adjustment Settings section in appropriate series sections.

Air/Oil Tanks should be considered when:

A. Energy per hour exceeds maximum rating for self-contained units.
B. Piston rod return sequence must be controlled.

Air/Oil Models, designated by the letter A before the model number (Example: AOEM), use air pressure over oil in a tank. An adapter (supplied with the shock absorber) is used in place of the fill plug to connect the shock absorber to the Air/Oil Tank, allowing fluid to flow between them. These methods replace the coil spring in a self-contained model to facilitate piston rod return. Consult factory for maximum air pressures. Air/Oil Tanks can be used with the Large ADEM Series (both standard adjustable as well as custom-orificed models), and ADEM Low Profile Series.

Important Mounting Considerations:
1. Always mount the shock absorber with the air/oil port facing up, regardless of mounting angle.
2. Always position the Air/Oil Tank above the shock absorber.
3. All port and line sizes must be as large as the shock absorber port size. Consult the factory for adapter port sizes.

Mounting and Installation for Rotary Motion

To minimize sideload (without a sideload adapter), the shock absorber should be mounted at a radius which is equal to or greater than 6.5 times the stroke of the piston.

\[ R_s \geq 6.5 \times S \]

To minimize sideload, the swing arm or impact pad should be perpendicular to the axis of the shock absorber when the piston is at midstroke, as shown.

Note: Recommended maximum sideload capability is 5° from centerline of shock absorber. Use of urethane or nylon striker cap is not recommended in rotary applications. Sideload adapters available for some models. See pages 26 and 44 for details.
Adjustable Hydraulic Series

Endine Adjustable Hydraulic Series shock absorbers offer the most flexible solutions to energy absorption application requirements when input parameters vary or are not clearly defined.

By simply turning an adjustment knob, the damping force can be changed to accommodate a wide range of conditions. Endine offers the broadest range of adjustable shock absorbers and mounting accessories in the marketplace today.

Features and Benefits

Adjustable design lets you “finetune” your desired damping and lock the numbered adjustment setting.

Internal orifice design provides deceleration with the most efficient damping characteristics, resulting in the lowest reaction forces in the industry.

Threaded cylinders provide mounting flexibility and increased surface area for improved heat dissipation.

Incorporated optional fluids and seal packages can expand the standard operating temperature range from (-10 to 80°C) to (-30 to 100°C).

A select variety of surface finishes maintains the original quality appearance and provides the longest corrosion resistance protection.

Operational parameters can be expanded through the use of Endine’s Low Range and High Performance products.

ISO quality standards result in reliable, long-life operation.

Custom orificed non-adjustable units (CBOEM) are available to meet specific application requirements.

The platinum OEM Small Series is designed to decelerate light-to-medium loads with the added benefit of corrosion resistant, nickel-plated components.

Endine Platinum Low Range (LROEM) models are available to control velocities as low as 0,08 m/sec and propelling forces as high as 3 335 N.

Together, they comprise the widest range of adjustable shock absorbers in the industry.

All models feature a small envelope size to accommodate space constraints.

The OEM Large Series is available with metric threads and bore diameters from 20mm to 50mm. These models are designed to decelerate medium-to-large loads.

The Endine Low Range OEM (LROEM) Large Series is available to control velocities as low as 0,08 m/sec and propelling forces as high as 17 790 N.

Both OEM and LROEM Large Series units are fully field repairable.

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Page 21
The Enidine 
OEM Low Profile Series
provides a recessed adjustment knob along with imperial threads and bore diameters of 20mm and 30mm for drop-in competitive interchange.

**Low Range (LROEM) Series** products are also available to control velocities as low as 0.08 m/sec and propelling forces as high as 17 790 N.

OEM Low Profile and LROEM Series shock absorbers are fully field repairable.

**High Performance (HP) Series** design is capable of softly decelerating impact velocities as high as 6.10 m/sec.

Wide range adjustability and multiple damping rates accommodate exact application needs.

---

### Adjustable Hydraulic Series

Use this Enidine Product Selection Guide to quickly locate potential adjustable shock absorber models most suited for your requirements. Models are organized in order of smallest to largest energy capacity per cycle within their respective product families.

#### ENIDINE ADJUSTABLE SHOCK ABSORBERS

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>(S) Stroke (mm)</th>
<th>(D) Max. Nm/cycle</th>
<th>(C) Max. Nm/hour</th>
<th>Damping Type</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEM 0.1M (B)</td>
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<tr>
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</tr>
</tbody>
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**Key for Damping Type:**

- D – Dashpot
- C – Conventional

---

Internet: www.enidine.de  
Phone: +49 (0) 7635 8101 0  
Fax: +49 (0) 7635 8101 99
Adjustment Technique

The damping force of an Enidine single orifice shock absorber can be changed by turning the adjustment knob. Maximum damping force is achieved by turning the adjustment knob to eight (8), while minimum damping force is achieved by turning the adjustment knob to zero (0). Turning the adjustment knob causes the adjustment ball to increase or decrease the clearance (orifice area) between the ball and its seat, depending on rotation direction.

The internal structure of adjustable single orifice shock absorber is shown above. When a force is applied to the piston rod, the check ball is seated and the valve remains closed. Oil is forced through the orifice, creating pressure on the piston head that provides the resisting force. When the load is removed, the compressed coil spring moves to reposition the piston head and the check ball unseats, opening the valve that permits rapid fluid return. The closed cellular foam accumulator is compressed by the oil during the stroke, compensating for the fluid displaced by the piston rod during compression. Without the fluid displacement volume provided by the foam accumulator, the system would be hydraulically locked. This type of orifice design produces constant orifice area damping.

Damping Type

Constant orifice area damping (Dashpot) provides the largest shock force at the beginning of the stroke when the impact velocity is highest. These shock absorbers provide high energy absorption in a small, economical design. This type of damping technology is also available in non-adjustable shock absorber models.
**Adjustment Technique**

The adjustable multiple orifice shock absorber is similar to the principles described earlier. The check ring replaces the check ball and the adjustment feature uses an adjustment pin instead of an adjustment ball. The damping force of the shock absorber can be changed by turning the adjustment knob. Maximum damping force is achieved by turning the adjustment knob to eight (8), while minimum damping force is achieved by turning the adjustment knob to zero (0).

Turning the adjustment knob rotates the adjustment cam within the shock absorber. The cam, in turn, moves the adjustment pin in the shock tube, closing or opening the orifice holes. By closing the orifice holes, the total orifice area of the shock absorber is reduced, thus increasing the damping force of the shock absorber. The adjustable shock absorber enables the user to change the damping force of the unit, should input conditions change, while still maintaining a conventional-type damping curve.

**Damping Type**

Conventional damping allows linear deceleration by providing a constant shock force over the entire stroke. This standard design is the most efficient, meaning it allows the most energy to be absorbed in a given stroke while providing the lowest shock force. This type of damping can be found in both adjustable and non-adjustable shock absorbers.
### Adjustable Hydraulic Series

#### OEM Platinum Series

#### OEM 0.1M → OEM 1.0M

<table>
<thead>
<tr>
<th>Catalog No. (Model)</th>
<th>Bore Size (mm)</th>
<th>Stroke (mm)</th>
<th>Optional Range (m/sec)</th>
<th>(E1) Max. Min./cycle</th>
<th>(E-C) Max. Min./hour</th>
<th>Fx1 Min. Shock Force (N)</th>
<th>Nominal Coil Spring Force</th>
<th>Weight (g)</th>
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<tr>
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<td>75.00</td>
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<tr>
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<td>25.0</td>
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<td>385.0</td>
<td>91.00</td>
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<td>890</td>
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<td>385.0</td>
<td>91.00</td>
<td>31.00</td>
<td>890</td>
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</tr>
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<td>25.0</td>
<td>0.08-1.30</td>
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<td>91.00</td>
<td>31.00</td>
<td>890</td>
<td>4.6</td>
</tr>
</tbody>
</table>

*Note: A1 and E1 apply to button models and urethane striker cap accessory.

**Notes:**
1. All Shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle.
2. For mounting accessories, see pages 22-30.
3. (B) indicates button model of shock absorber. Buttons cannot be added to non-button models or removed from button models OEM .1M to OEM 1.0M.
4. Urethane striker caps are available as accessories for models OEM 1.15M x 1 to OEM 1.25M x 2.
### Adjustable Hydraulic Series

#### OEM Low Profile Series

#### OEM 3/4 → OEM 1 1/8

![Diagram of Adjusted Hydraulic Series](image)

*Note: A1 and E1 apply to urethane striker cap accessory.

<table>
<thead>
<tr>
<th>Catalog No. (Model)</th>
<th>øD</th>
<th>øE</th>
<th>øF</th>
<th>øG</th>
<th>øH</th>
<th>øI</th>
<th>øJ</th>
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</table>

### Catalog Information

- **Catalog No.**: Reference number for catalog entry.
- **øD**: Diameter of bore size.
- **øE**: Diameter of external diameter.
- **øF**: Diameter of internal diameter.
- **øG**: Diameter of internal diameter.
- **øH**: Diameter of internal diameter.
- **øI**: Diameter of internal diameter.
- **øJ**: Diameter of internal diameter.

### Notes

1. All shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than 5%, a smaller model should be specified.
2. Air/Oil (AOEM, LRAOEM) models – max. energy per hour is 20% higher than the standard OEM/LROEM models.
3. For mounting accessories, see pages 22-30.
4. Rear flange mounting not recommended for OEM 1 1/8 x 6 when mounting horizontally.

### Specifications

- **Max. Shock Force**: Maximum shock force application.
- **Max. Propelling Force**: Maximum propelling force application.
- **Nominal Spring Force**: Nominal spring force application.

### Dimensions

- **WF**: Weight of the component.
- **WL**: Length of the component.

---

*All dimensions in millimeters.*
### Adjustable Hydraulic Series

#### OEM Large Series

**OEM 1.5M → OEM 4.0M**

#### Notes:
1. All shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than 5%, a smaller model should be specified.
2. Air/Oil (AOEM, LRAOEM) models – max. energy per hour is 20% higher than the standard OEM/LROEM models (see page 14).
3. For mounting accessories, see pages 22-30.
4. Rear flange mounting of OEM 2.0M x 6, OEM 3.0M x 6.5, OEM 4.0M x 8 and OEM 4.0M x 10 models not recommended when mounting horizontally.

#### Nominal Coil Spring Force

<table>
<thead>
<tr>
<th>Model</th>
<th>Catalog No. (Model)</th>
<th>Size (mm)</th>
<th>Stroke (mm)</th>
<th>Velocity (m/sec)</th>
<th>Force (N)</th>
<th>Shock Extended Nm/cycle</th>
<th>Shock Compressed Nm</th>
<th>Propelling Weight (kg)</th>
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<td>80</td>
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#### All dimensions in millimeters.

**ADJUSTABLES**

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*Note: A1 and E1 apply to urethane striker cap accessory.*
### Adjustable Hydraulic Series

#### Clevis Mounting

**Catalog No.**

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<tr>
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<th>M</th>
<th>N</th>
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<th>T</th>
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<td>394 g</td>
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**Notes:**
1. Clevis mount not recommended for OEM 2.0M x 6, OEM 3.0M x 6.5, OEM 4.0M x 8 and<br>OEM 4.0M x 10 models when mounted horizontally.
2. “S” designation model is supplied with spring.

**Dimensions in millimeters.**
Adjustable Hydraulic Series

Useable Adjustment Settings

After properly sizing the shock absorber, the useable range of adjustment settings for the application can be determined:

1. Locate the intersection point of the application’s impact velocity and the selected model graph line.
2. The intersection is the maximum adjustment setting to be used. Adjustments exceeding this maximum suggested setting could overload the shock absorber.
3. The useable adjustment setting range is from the 0 setting to the maximum adjustment setting as determined in step 2.

Example: OEM 1.25M x 1
1. Impact Velocity: 1.0 m/sec
2. Intersection Point: Adjustment Setting 5
3. Useable Adjustment Setting Range: 0 to 5

Example: LROEM 1⅛ x 2
1. Impact Velocity: 0.5 m/sec
2. Intersection Point: Adjustment Setting 3
3. Useable Adjustment Setting Range: 0 to 3

Position 0 provides minimum damping force, position 8 provides maximum damping force.

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<tr>
<th>IMPACT VELOCITY (m/sec)</th>
<th>ADJUSTMENT SETTING</th>
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<td>1.0</td>
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</table>

Platinum OEM Small Series

180° adjustment with setscrew locking. (OEM 0.1M – OEM .5M)

Platinum Low Range OEM Small Series

180° adjustment with setscrew locking. (LROEM .15M – LROEM .5M)

OEM Large

180° adjustment with setscrew locking. (OEM 1.0M – OEM 4.0M)

Low Range OEM Large

180° adjustment with setscrew locking. (LROEM 1.0M and LROEM 2.0M)
### Adjustable Hydraulic Series

#### HP Series

![Adjustment Knob](image1)

**Hex Jam Nut**

---

#### Catalog and Dimensions

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Bare Size (mm)</th>
<th>(D) Stroke (mm)</th>
<th>Optional Velocity Max. Range (m/sec)</th>
<th>(E) Max. Min./cycle</th>
<th>(F) Max. Shock Force (Nm)</th>
<th>Nominal Coil Spring Force</th>
<th>Model</th>
<th>Shock Extended (Nm)</th>
<th>Compressed (Nm)</th>
<th>Propelling Weight (g)</th>
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<td>14</td>
<td>40</td>
<td>4.0 – 6.0</td>
<td>190</td>
<td>75 000</td>
<td>7 500</td>
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<td>49</td>
<td>2 200</td>
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*All dimensions in millimeters.*

---

#### Hex Jam Nut Dimensions

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<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>JA</th>
<th>JB</th>
<th>JH</th>
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<td>M25 x 1.5</td>
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<td>HP110MC-1, -2, -3</td>
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<td>8</td>
<td>22</td>
<td>138</td>
<td>22</td>
<td>20</td>
<td>36.7</td>
<td>31.8</td>
<td>4.6</td>
</tr>
</tbody>
</table>

*All dimensions in millimeters.*
Adjustable Hydraulic Series

**HP Series Shock Absorber Sizing**

1. Determine load weight (kg), impact velocity (m/sec), propelling force (N) if any, and cycles per hour.
2. Calculate total energy per cycle (Nm/c) and total energy per hour (Nm/hr). Consult this catalog’s sizing section (pages 5-12) for assistance if required.
3. Compare the calculated total energy per cycle (Nm/c), total energy per hour (Nm/hr) and propelling force (kg) to the values listed above.
4. Locate the intersection point of the determined impact velocity (m/sec) and total energy per cycle (Nm/c) on the sizing graph to select the appropriate model.
5. Refer to the usable adjustment settings graph (below) to determine the maximum adjustment setting.
6. Contact Enidine for applications with requirements which fall outside the sizing graph.

**Example: Horizontal Application**

1. Weight (W): 16 kg
   Impact Velocity (V): 4.5 m/sec
   Propelling Force (Fp): None
   Cycles/Hour (C): 80
2. Total Energy/Cycle (Ei): 162 Nm/c
   Total Energy/Hour (Eh): 12 960 Nm/hr
3. Compare total energy/cycle (162 Nm) and total energy/hour (12 960 Nm/hr) to the HP Engineering Data chart.
4. Intersection Point: HP 110 MC-1

**Useable Adjustment Settings**

After properly sizing the shock absorber, the usable range of adjustment settings for the application can be determined.

1. Locate the intersection point of the application’s impact velocity and the selected HP model graph line.
2. The intersection is the maximum adjustment setting to be used. Adjustments exceeding this setting could overload the shock absorber.
3. The useable adjustment range is from the 0 setting to the maximum adjustment setting as determined in step 2.

**Example: HP 110 MF/MC-1**

1. Impact Velocity: 4.5 m/sec
2. Intersection Point: Adjustment Setting 6
3. Useable Adjustment Setting Range: 0 to 6

**Useable Adjustment Settings**

Position 0 provides minimum damping force, position 8 provides maximum damping force.

180° adjustment with setscrew locking.
### STOP COLLAR (SC)

Adjustable Hydraulic Series Accessories

#### Catalog Number

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<th>Part Number</th>
<th>Model (Ref)</th>
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<th>CD</th>
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All dimensions in millimeters.

#### Notes:
1. To be used with non-button models only.
2. Maximum sideload angle is 30°.

### SIDE LOAD ADAPTERS (SLA)

Adjustable Hydraulic Series Accessories

#### Catalog Number

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Notes:
1. To be used with non-button models only.
2. Maximum sideload angle is 30°.

All dimensions in millimeters.
Adjustable Hydraulic Series Accessories

JAM NUT (JN)

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All dimensions in millimeters.

LOCK RING (LR)

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All dimensions in millimeters.

SQUARE FLANGE (SF)

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All dimensions in millimeters.
Adjustable Hydraulic Series Accessories

**RECTANGULAR FLANGE (RF)**

![Diagram of RF](image)

**STOP BAR KIT (SB)**

![Diagram of SB](image)

**URETHANE STRIKER CAP (UC)**

![Diagram of UC](image)
Adjustable Hydraulic Series Accessories

Accessories

FOOT MOUNT (FM)

Typical Foot Mount Installation

OEM 1.15M → OEM 1.25M

OEM 3.0M

OEM 4.0M

<table>
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<th>Part Number</th>
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<th>FK</th>
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<th>Weight (g)</th>
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<td>72.2</td>
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<td>100</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>FM 1 1/4-12</td>
<td>2F212940</td>
<td>OEM 1/2”</td>
<td>86.3</td>
<td>72.0</td>
<td>95.3</td>
<td>76.2</td>
<td>8.6</td>
<td>55.0</td>
<td>12.7</td>
<td>29.5</td>
<td>9.7</td>
<td>19.1</td>
<td>M8</td>
<td>350</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>FM 1 1/2-12</td>
<td>2F33010</td>
<td>OEM 3/4”</td>
<td>76.3</td>
<td>39.6</td>
<td>143.0</td>
<td>124.0</td>
<td>10.4</td>
<td>89.7</td>
<td>16.0</td>
<td>84.5</td>
<td>11.2</td>
<td>22.4</td>
<td>M10</td>
<td>1 050</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FM M42 x 1.5</td>
<td>2F29400</td>
<td>OEM 1.5M</td>
<td>66.5</td>
<td>72.0</td>
<td>95.3</td>
<td>76.2</td>
<td>8.6</td>
<td>55.0</td>
<td>12.7</td>
<td>29.5</td>
<td>9.7</td>
<td>19.1</td>
<td>M8</td>
<td>370</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>FM M64 x 2</td>
<td>2F3010</td>
<td>OEM 2.0M</td>
<td>96.2</td>
<td>39.6</td>
<td>143.0</td>
<td>124.0</td>
<td>10.4</td>
<td>89.7</td>
<td>16.0</td>
<td>84.5</td>
<td>11.2</td>
<td>22.4</td>
<td>M10</td>
<td>1 080</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>FM M85 x 2</td>
<td>2F3300</td>
<td>OEM 3.0M</td>
<td>76.0</td>
<td>59.0</td>
<td>165.0</td>
<td>139.7</td>
<td>13.5</td>
<td>103.0</td>
<td>25.4</td>
<td>52.3</td>
<td>14.1</td>
<td>28.7</td>
<td>M12</td>
<td>1 904</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FM M115 x 2</td>
<td>2F3200</td>
<td>OEM 4.0M</td>
<td>74.0</td>
<td>37.6</td>
<td>203.2</td>
<td>165.0</td>
<td>16.8</td>
<td>149.4</td>
<td>38.0</td>
<td>79.5</td>
<td>16.0</td>
<td>50.8</td>
<td>M16</td>
<td>3 900</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. OEM 1 1/4 x 6, Z dimension is 68.3mm.
2. OEM 2.0M x 6, Z dimension is 68.3mm.
3. OEM 3.0M x 6, Z dimension is 77.7mm.
4. OEM 4.0M x 8 and 4.0M x 10M, Z dimension is 62.0mm.
5. Shock absorber must be ordered separately from the foot mount kit.
6. All foot mount kits include two foot mounts. A lock ring is also supplied with all kits but the OEM 4.150C/1.250M foot mount kit.
7. For rear foot mount, dimension FJ is 22.4mm.
## Adjusted Hydraulic Series

**Accessories**

### UNIVERSAL RETAINING FLANGE (SMALL BORE) (UF)

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Part Number</th>
<th>Model (Ref)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>UF M10 x 1</td>
<td>U1663189</td>
<td>OEM 0.1M (B)</td>
<td>38,0</td>
<td>12,0</td>
<td>6,0</td>
<td>6,25</td>
<td>25,5</td>
<td>25,0</td>
<td>12,5</td>
<td></td>
</tr>
<tr>
<td>UF M12 x 1</td>
<td>U1556189</td>
<td>OEM 0.15M (B)</td>
<td>38,0</td>
<td>12,0</td>
<td>6,0</td>
<td>6,25</td>
<td>25,5</td>
<td>25,0</td>
<td>12,5</td>
<td></td>
</tr>
<tr>
<td>UF M14 x 1.5</td>
<td>U1395143</td>
<td>OEM 0.25M (B)</td>
<td>45,0</td>
<td>16,0</td>
<td>8,0</td>
<td>5,0</td>
<td>35,0</td>
<td>30,0</td>
<td>15,0</td>
<td></td>
</tr>
<tr>
<td>UF M16 x 1.5</td>
<td>U19018143</td>
<td>OEM 0.35M (B)</td>
<td>45,0</td>
<td>16,0</td>
<td>8,0</td>
<td>5,0</td>
<td>35,0</td>
<td>30,0</td>
<td>15,0</td>
<td></td>
</tr>
<tr>
<td>UF M20 x 1.5</td>
<td>U1346143</td>
<td>OEM 0.5M (B)</td>
<td>50,0</td>
<td>20,0</td>
<td>10,0</td>
<td>6,5</td>
<td>40,0</td>
<td>35,0</td>
<td>17,5</td>
<td></td>
</tr>
</tbody>
</table>

*Please use special jam nuts only.

All dimensions in millimeters.

### Shock Absorbers

**10 - OEM 1.0M**

Select quantity

Select catalog number:
- OEM, HP (Adjustable)
- LROEM (Low range adjustable)
- CBOEM (Non-adjustable)

Select piston rod type:
- "___" (No button)
- "B" (Button model, OEM 0.1M, 0.25M, 0.5M, 1.0M and 1.0MF/HP only)
- "CM" (Clevis mount)

Application Data

Required for CBOEM and CBAOEM models only:
- Vertical or Horizontal motion
- Weight
- Impact velocity
- Propelling force (if any)
- Other (temperature or other environmental conditions)
- Cycles per hour

### Accessories

**Example 1**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>LR M45 x 1.5 (P/N F8637049)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select quantity</td>
<td>Select catalog/part number</td>
</tr>
</tbody>
</table>

**Example 2**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>UC 2940 (P/N C92940079)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select quantity</td>
<td>Select catalog/part number</td>
</tr>
</tbody>
</table>

---

*Phone: +49 (0) 7635 8101 0  Fax: +49 (0) 7635 8101 99*
Non-Adjustable Hydraulic Series

Enidine non-adjustable hydraulic shock absorbers can accommodate varying energy conditions. This family of tamperproof shock absorbers provides consistent performance, cycle after cycle. Non-adjustable models are designed to absorb maximum energy within a compact envelope size.

Features and Benefits

- Extensive non-adjustable product line offers flexibility in both size and energy absorption capacity to fulfill a wide range of application requirements.
- Tamperproof design ensures repeatable performance.
- Special materials and finishes can be designed to meet specific customer requirements.
- Incorporating optional fluids and seal packages can expand the standard operating temperature range from (-10°C to 80°C) to (-30°C to 100°C).
- Threaded cylinders provide mounting flexibility and increase surface area for improved heat dissipation.
- A select variety of surface finishes maintains the original quality appearance and provides the longest corrosion resistance protection.
- ISO quality standards result in reliable, long-life operation.

The Platinum PRO Series has unique progressive damping and multi-orifice design that provides softer stops for medium-to-high impact velocities and fragile loads. The Platinum PRO Series also includes the added benefit of corrosion-resistant, nickel-plated components and positive stop capabilities. Models can accommodate a wide range of operating conditions.

The PM Series uses a self-compensating design to provide energy absorption in low velocity and high drive force applications. The Platinum PM Series also includes the added benefit of corrosion-resistant, nickel-plated components and positive stop capabilities. Models can accommodate a wide range of operating conditions with varying masses or propelling forces.
The **Enidine STH Series** offers the highest energy absorption capacity relative to its size. These custom-orificed shock absorbers are designed to meet exact application requirements. STH Series shock absorbers are available in fully threaded cylinder bodies, providing flexibility in mounting configurations.

**Page 34**

The **TK Series** is a versatile, miniature design which provides effective, reliable deceleration and vibration control for light loads. Models can accommodate a wide range of operating conditions.

**Page 34**
Non-Adjustable Multiple Orifice Shock Absorber

The design of a multi-orifice shock absorber features a double cylinder arrangement with space between the concentric shock tube and cylinder, and a series of orifice holes drilled down the length of the shock tube wall.

During piston movement, the check ring is seated and oil is forced through the orifices in the shock tube wall, into the closed cellular foam accumulator and behind the piston head. The orifice area decreases as the piston head moves and closes the orifice holes. During repositioning, the coil spring pushes the piston rod outward. This unseats the check ring and permits the oil to flow from the accumulator and across the piston head, back into the shock tube. Multiple orifice shock absorbers can provide conventional, progressive or self-compensating damping.

Damping Types

**Conventional damping** allows linear deceleration by providing a constant shock force over the entire stroke. This standard design is the most efficient, meaning it allows the most energy to be absorbed in a given stroke, while providing the lowest shock force. This type of damping is also available in adjustable shock absorbers.

**Progressive damping** provides deceleration with a gradually increasing shock force. The initial minimal resistance at impact protects delicate loads and machinery from damage. Progressive damping shock absorbers also have built-in self-compensation, so they can operate over a wide range of weights and velocities. This type of damping provides smooth deceleration in applications where energy conditions may change.

**Self-compensating damping** maintains acceptable deceleration with conventional type damping characteristics. Self-compensating shock absorbers operate over a wide range of weights and velocities. These shock absorbers are well suited for high drive force, low velocity applications, and where energy conditions may change. Curve A shows the shock force vs. stroke curve of a self-compensating shock absorber impacted with a low velocity and high drive force. Curve B shows the shock force vs. stroke curve of a self-compensating shock absorber impacted with a high velocity and low drive force.

**Constant orifice area damping (Dashpot)** provides the largest shock force at the beginning of the stroke when impact velocity is highest. These shock absorbers provide high energy absorption in a small, economical design. This type of damping is also available in adjustable shock absorbers.
## Non-Adjustable Hydraulic Series

**TK and STH Series**

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Size (mm)</th>
<th>Stroke (mm)</th>
<th>Max. Force (N)</th>
<th>Max. Force (Nm/hour)</th>
<th>Model Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TK 6M</td>
<td>29.0</td>
<td>25.0</td>
<td>4,000</td>
<td>2,700</td>
<td>1,000</td>
</tr>
<tr>
<td>TK 21M</td>
<td>35.4</td>
<td>25.0</td>
<td>2,100</td>
<td>1,300</td>
<td>5,000</td>
</tr>
<tr>
<td>TK 10M (B)</td>
<td>44.6</td>
<td>25.0</td>
<td>1,000</td>
<td>800</td>
<td>20,000</td>
</tr>
</tbody>
</table>

*Note: A positive stop is required to prevent the bottoming of the TK 21 shock absorber.*

### Notes:
1. A positive stop is required to prevent the bottoming of the TK 21 shock absorber.
2. All dimensions in millimeters.
3. All shock absorbers will function at 5% of their rated energy per cycle. If less than 5%, a smaller model should be specified.

### Internet:
- **www.enidine.de**
- **Phone:** +49 (0) 7635 8101 0
- **Fax:** +49 (0) 7635 8101 99
Non-Adjustable Hydraulic Series

PM Series

The Platinum PM Series uses a self-compensating design to provide energy absorption in low velocity and high drive force applications. Models can accommodate a wide range of operating conditions with varying masses or propelling forces.

Notes:
1. (B) indicates button model of shock absorber. Buttons cannot be added to non-button models or removed from button models.
2. Urethane striker caps are available as accessories for models PM 120 to PM 225.
3. A1 and E1 apply to button models and urethane striker cap accessory.
4. A1 and E1 apply to button models and urethane striker cap accessory.

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Damping Coefficient</th>
<th>Bore Size (mm)</th>
<th>Stroke (mm)</th>
<th>(E1) Max. Damping Nm/cycle</th>
<th>(E2) Max. Shock Force (N)</th>
<th>Nominal Coil Spring Force (N)</th>
<th>(F3) Max. Propelling Force (N)</th>
<th>Model Wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMX 8 MF (B)</td>
<td>-1, -2, -3</td>
<td>4,6</td>
<td>6,4</td>
<td>3,0</td>
<td>5 650</td>
<td>890</td>
<td>2,2</td>
<td>5,8</td>
</tr>
<tr>
<td>PMX 8 MC (B)</td>
<td>-1, -2, -3</td>
<td>4,6</td>
<td>6,4</td>
<td>3,0</td>
<td>5 650</td>
<td>890</td>
<td>2,2</td>
<td>5,8</td>
</tr>
<tr>
<td>PMX 10 MF (B)</td>
<td>-1, -2, -3</td>
<td>6,0</td>
<td>7,6</td>
<td>6,0</td>
<td>12 400</td>
<td>1 600</td>
<td>3,2</td>
<td>4,5</td>
</tr>
<tr>
<td>PM 15 MF (B)</td>
<td>-1, -2, -3</td>
<td>9,4</td>
<td>10,4</td>
<td>10,0</td>
<td>20 200</td>
<td>2 000</td>
<td>3,3</td>
<td>7,0</td>
</tr>
<tr>
<td>SPM 25 MF (B)</td>
<td>-1, -2, -3</td>
<td>7,0</td>
<td>12,7</td>
<td>20,0</td>
<td>33 800</td>
<td>2 800</td>
<td>6,0</td>
<td>13,0</td>
</tr>
<tr>
<td>SPM 25 MC (B)</td>
<td>-1, -2, -3</td>
<td>7,0</td>
<td>12,7</td>
<td>20,0</td>
<td>33 800</td>
<td>2 800</td>
<td>6,0</td>
<td>13,0</td>
</tr>
<tr>
<td>PM 25 MF (B)</td>
<td>-1, -2, -3</td>
<td>7,1</td>
<td>16,0</td>
<td>24,0</td>
<td>34 000</td>
<td>2 800</td>
<td>4,0</td>
<td>14,0</td>
</tr>
<tr>
<td>PM 25 MC (B)</td>
<td>-1, -2, -3</td>
<td>7,1</td>
<td>16,0</td>
<td>24,0</td>
<td>34 000</td>
<td>2 800</td>
<td>4,0</td>
<td>14,0</td>
</tr>
<tr>
<td>SPM 50 MF (B)</td>
<td>-1, -2, -3</td>
<td>11,0</td>
<td>17,7</td>
<td>28,0</td>
<td>45 200</td>
<td>3 750</td>
<td>6,5</td>
<td>15,0</td>
</tr>
<tr>
<td>PM 50 MF (B)</td>
<td>-1, -2, -3</td>
<td>11,0</td>
<td>17,7</td>
<td>28,0</td>
<td>45 200</td>
<td>3 750</td>
<td>6,5</td>
<td>15,0</td>
</tr>
<tr>
<td>PM 50 MC (B)</td>
<td>-1, -2, -3</td>
<td>11,3</td>
<td>22,0</td>
<td>34,0</td>
<td>53 700</td>
<td>3 750</td>
<td>9,0</td>
<td>20,0</td>
</tr>
<tr>
<td>PM 100 MF (B)</td>
<td>-1, -2, -3</td>
<td>12,7</td>
<td>25,0</td>
<td>96,0</td>
<td>70 000</td>
<td>5 500</td>
<td>14,0</td>
<td>27,0</td>
</tr>
<tr>
<td>PM 100 MC (B)</td>
<td>-1, -2, -3</td>
<td>12,7</td>
<td>25,0</td>
<td>96,0</td>
<td>70 000</td>
<td>5 500</td>
<td>14,0</td>
<td>27,0</td>
</tr>
<tr>
<td>PM 120 MF (B)</td>
<td>-1, -2, -3</td>
<td>16,0</td>
<td>25,0</td>
<td>160,0</td>
<td>75 700</td>
<td>11 120</td>
<td>56,0</td>
<td>1 200</td>
</tr>
<tr>
<td>PM 125 MF (B)</td>
<td>-1, -2, -3</td>
<td>16,0</td>
<td>25,0</td>
<td>160,0</td>
<td>75 700</td>
<td>11 120</td>
<td>56,0</td>
<td>1 200</td>
</tr>
<tr>
<td>PM 220 MF (B)</td>
<td>-1, -2, -3</td>
<td>16,0</td>
<td>45,0</td>
<td>310,0</td>
<td>90 800</td>
<td>11 120</td>
<td>71,0</td>
<td>1 200</td>
</tr>
<tr>
<td>PM 225 MF (B)</td>
<td>-1, -2, -3</td>
<td>16,0</td>
<td>45,0</td>
<td>310,0</td>
<td>90 800</td>
<td>11 120</td>
<td>71,0</td>
<td>1 200</td>
</tr>
<tr>
<td>PM 225 MF (B)</td>
<td>-1, -2, -3</td>
<td>16,0</td>
<td>45,0</td>
<td>310,0</td>
<td>90 800</td>
<td>11 120</td>
<td>71,0</td>
<td>1 200</td>
</tr>
</tbody>
</table>

Notes:
1. PMX 8M, PMX 10M and SPM 25M have 1.5 mm inch wide screwdriver slot.
2. (B) indicates button model of shock absorber. Buttons cannot be added to non-button models or removed from button models.
3. A1 and E1 apply to button models and urethane striker cap accessory.

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Non-Adjustable Hydraulic Series

PM Series Sizing Graphs

PMX 8M

PM 10M

PM 15M

SPM 25M

SPM 50M

TOTAL ENERGY (Nm/c)

IMPACT VELOCITY (m/sec)

PM 50M

PM 100M

TOTAL ENERGY (Nm/c)

IMPACT VELOCITY (m/sec)

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Non-Adjustable Hydraulic Series

PM Series Sizing Graphs

PM 120M/125M

PM 220M/235M

PM 1525M → PM 2150M

**Notes:**
- A1 and E1 apply to urethane striker cap accessory.

### Catalog No. (Model)

<table>
<thead>
<tr>
<th>PM 120M/125M</th>
<th>PM 220M/235M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Catalog No.</strong></td>
<td><strong>Model</strong></td>
</tr>
<tr>
<td>PM 1525M</td>
<td>PM 120M/125M</td>
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<tr>
<td>PM 1550M</td>
<td>PM 1525M</td>
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<td>PM 1575M</td>
<td>PM 1550M</td>
</tr>
<tr>
<td>PM 2050M</td>
<td>PM 1575M</td>
</tr>
<tr>
<td>PM 2100M</td>
<td>PM 2050M</td>
</tr>
<tr>
<td>PM 2150M</td>
<td>PM 2100M</td>
</tr>
</tbody>
</table>

**Notes:**
- B indicates button model of shock absorber. Buttons cannot be added to non-button models or removed from button models.
- Urethane striker caps are available as accessories for models PM 1525M to PM 2150M.

The Nominal Coil Spring Force and the Shock Weight are given in Newtons (N).

**Note:** Minimum impact velocity for PM models is 0.1 m/sec.

---

**Internet:** www.enidine.de  **Phone:** +49 (0) 7635 8101 0  **Fax:** +49 (0) 7635 8101 99
Non-Adjustable Hydraulic Series
PM Series Sizing Graphs

Note: Minimum impact velocity for PM models is 0.1 m/sec
Non-Adjustable Hydraulic Series

PRO Series

The Platinum PRO Series has unique progressive damping and a multi-orifice design providing softer stops for medium to high impact velocities and fragile loads. Models can accommodate a wide range of operating conditions.

**PRO 15M → PRO 100M**

**PRO 110M → PRO 225M**

### Catalog No.

<table>
<thead>
<tr>
<th>(Model)</th>
<th>Damping Constant</th>
<th>(S) Stroke (mm)</th>
<th>(E) Max. Spring Force (Nm/cycle)</th>
<th>(E) Max. Shock Force (Nm)</th>
<th>Nominal Coil</th>
<th>Max. Spring Force (Nm)</th>
<th>Max. Shock Force (Nm)</th>
<th>Extended (N)</th>
<th>Compressed (N)</th>
<th>Propelling Force (N)</th>
<th>Model Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRO 15 MF (B)</td>
<td>-1, -2, -3</td>
<td>6,0</td>
<td>10,4</td>
<td>18,0</td>
<td>26,000</td>
<td>2,800</td>
<td>4,0</td>
<td>18,0</td>
<td>530</td>
<td>500</td>
<td>5000</td>
</tr>
<tr>
<td>PRO 25 MF (B)</td>
<td>-1, -2, -3</td>
<td>7,1</td>
<td>16,0</td>
<td>26,0</td>
<td>28,000</td>
<td>2,800</td>
<td>4,0</td>
<td>18,0</td>
<td>530</td>
<td>500</td>
<td>5000</td>
</tr>
<tr>
<td>PRO 25 MC (B)</td>
<td>-1, -2, -3</td>
<td>7,7</td>
<td>16,0</td>
<td>26,0</td>
<td>28,000</td>
<td>2,800</td>
<td>4,0</td>
<td>18,0</td>
<td>530</td>
<td>500</td>
<td>5000</td>
</tr>
<tr>
<td>PRO 50 MC (B)</td>
<td>-1, -2, -3</td>
<td>13,1</td>
<td>32,0</td>
<td>54,0</td>
<td>53,700</td>
<td>7,350</td>
<td>9,0</td>
<td>30,0</td>
<td>890</td>
<td>800</td>
<td>8000</td>
</tr>
<tr>
<td>PRO 100 MF (B)</td>
<td>-1, -2, -3</td>
<td>12,7</td>
<td>25,0</td>
<td>90,0</td>
<td>79,000</td>
<td>5,500</td>
<td>14,0</td>
<td>27,0</td>
<td>1,550</td>
<td>1,250</td>
<td>12500</td>
</tr>
<tr>
<td>PRO 100 MC (B)</td>
<td>-1, -2, -3</td>
<td>12,7</td>
<td>25,0</td>
<td>90,0</td>
<td>79,000</td>
<td>5,500</td>
<td>14,0</td>
<td>27,0</td>
<td>1,550</td>
<td>1,250</td>
<td>12500</td>
</tr>
<tr>
<td>PRO 110 MF (B)</td>
<td>-1, -2, -3</td>
<td>14,0</td>
<td>40,0</td>
<td>190,0</td>
<td>75,700</td>
<td>7,500</td>
<td>18,0</td>
<td>49,0</td>
<td>2,200</td>
<td>1,800</td>
<td>18000</td>
</tr>
<tr>
<td>PRO 110 MC (B)</td>
<td>-1, -2, -3</td>
<td>14,0</td>
<td>40,0</td>
<td>190,0</td>
<td>75,700</td>
<td>7,500</td>
<td>18,0</td>
<td>49,0</td>
<td>2,200</td>
<td>1,800</td>
<td>18000</td>
</tr>
<tr>
<td>PRO 120 MF (B)</td>
<td>-1, -2, -3</td>
<td>16,0</td>
<td>25,0</td>
<td>160,0</td>
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<td>7,500</td>
<td>18,0</td>
<td>49,0</td>
<td>2,200</td>
<td>1,800</td>
<td>18000</td>
</tr>
<tr>
<td>PRO 125 MF (B)</td>
<td>-1, -2, -3</td>
<td>17,6</td>
<td>25,0</td>
<td>160,0</td>
<td>87,500</td>
<td>11,120</td>
<td>14,0</td>
<td>33,0</td>
<td>3100</td>
<td>2500</td>
<td>25000</td>
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<tr>
<td>PRO 220 MF (B)</td>
<td>-1, -2, -3</td>
<td>16,0</td>
<td>40,0</td>
<td>310,0</td>
<td>90,300</td>
<td>11,120</td>
<td>31,0</td>
<td>59,0</td>
<td>2,200</td>
<td>1,800</td>
<td>18000</td>
</tr>
<tr>
<td>PRO 225 MF (B)</td>
<td>-1, -2, -3</td>
<td>16,0</td>
<td>40,0</td>
<td>310,0</td>
<td>90,300</td>
<td>11,120</td>
<td>31,0</td>
<td>59,0</td>
<td>2,200</td>
<td>1,800</td>
<td>18000</td>
</tr>
</tbody>
</table>

### Notes:

1. (B) indicates button model of shock absorber. Buttons cannot be added to non-button models or removed from button models.
2. Urethane striker caps are available as accessories for models PRO 120M to PRO 225M.

---

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Non-Adjustable Hydraulic Series

PRO Series Sizing Graphs

Note: Minimum impact velocity for PRO models is 0.25 m/sec

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Non-Adjustable Hydraulic Series Accessories

### JAM NUT (JN)

- **Catalog No.**
- **Part Numbers**
- **Model (Ref)**
- **JA**
- **JB**
- **JH**
- **Wt (g)**

| JN M8 x 0.75 | 02 9137 015 | PMX 8MF | 14.0 | 12.0 | 4.0 | 2 |
| JN M8 x 1 | 02 9137 015 | PMX 8MC | 14.0 | 12.0 | 4.0 | 2 |
| JN M10 x 1 | 02 4201 015 | SPM/PM/PRO 10MC | 19.7 | 17.0 | 4.0 | 3 |
| JN M12 x 1 | 02 3580 015 | SPM/PM/PRO 12MC | 16.7 | 14.0 | 4.0 | 2 |
| JN M14 x 1,5 | 02 3953 015 | SPM/PM/PRO 14MC | 19.7 | 17.0 | 4.0 | 3 |
| JN M20 x 1,5 | 02 3946 015 | SPM/PM/PRO 20MC | 27.7 | 24.0 | 4.6 | 9 |
| JN M22 x 1,5 | 02 4102 015 | STH 22M | 21.5 | 18.0 | 5.5 | 12 |
| JN M25 x 1,5 | 02 3904 015 | PRO/PRO 25MC | 19.7 | 17.0 | 4.0 | 3 |
| JN M25 x 2 | 02 3580 015 | PRO 25MC | 16.7 | 14.0 | 4.0 | 2 |
| JN M27 x 3 | 02 3587 015 | PRO/PRO 30MC | 27.0 | 24.0 | 4.6 | 9 |
| JN M30 x 2 | 02 3580 015 | STH 30M | 41.6 | 36.0 | 7.0 | 24 |
| JN M33 x 1,5 | 02 8069 015 | PM 120/220MF | 47.3 | 41.0 | 6.4 | 27 |
| JN M36 x 1,5 | 02 8164 015 | PM 150/250MF | 47.3 | 41.0 | 6.4 | 27 |

All dimensions in millimeters.

### LOCK RING (LR)

- **Catalog No.**
- **Part Numbers**
- **Model (Ref)**
- **B**
- **LH**
- **Weight (g)**

| LR M45 x 1,5 | 08637004F | PM 150 Series/STH 1.5M | 15.7 | 9.5 | 75 |
| LR M64 x 2 | 08637004F | PM 200 Series | 72.9 | 12.7 | 85 |

All dimensions in millimeters.
Non-Adjustable Hydraulic Series Accessories

**SQUARE FLANGE (SF)**

![Image of Square Flange (SF)]

**RECTANGULAR FLANGE (RF)**

![Image of Rectangular Flange (RF)]

**FOOT MOUNT KIT (FM)**

![Image of Foot Mount Kit (FM)]

## Accessories

### Non-Adjustables

<table>
<thead>
<tr>
<th>Foot Mount Kit (FM)</th>
<th>Typical Foot Mount Installation</th>
</tr>
</thead>
</table>

### Catalogs

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Part Number</th>
<th>Model (Ref)</th>
<th>FC</th>
<th>FH</th>
<th>SA</th>
<th>SB</th>
<th>Bolt Size</th>
<th>Weight (g)</th>
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<tbody>
<tr>
<td>FM M33 x 1.5</td>
<td>3931993906</td>
<td>PM 120/220M</td>
<td>57.2</td>
<td>38.9</td>
<td>40.3</td>
<td>43.0</td>
<td>12.7</td>
<td>4.5</td>
</tr>
<tr>
<td>FM M36 x 1.5</td>
<td>3931993906</td>
<td>PM 120/220M</td>
<td>57.2</td>
<td>38.9</td>
<td>40.3</td>
<td>43.0</td>
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</tr>
<tr>
<td>FM M45 x 1.5</td>
<td>3931993906</td>
<td>PM 120/220M</td>
<td>57.2</td>
<td>38.9</td>
<td>40.3</td>
<td>43.0</td>
<td>12.7</td>
<td>4.5</td>
</tr>
</tbody>
</table>

### Notes:
1. PM 120M, PM 220M, PRO 125M, PRO 225M
2. All dimensions in millimeters.
3. All foot mount kits include two foot mounts. A lock ring is also supplied for the PM 1500M and PM 2000M Series.

---

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Endine
**Non-Adjustable Hydraulic Series Accessories**

**STOP COLLAR (SC)**

PMX 8M

- Hex Jam Nut (not included)

PMX 10M → PM 220M

- PRO 15M → PRO 225M

TK 10M

PM 1525M → PM 2150M

- Lock Ring (not included)

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Part Number</th>
<th>Model (Ref)</th>
<th>CA</th>
<th>CB</th>
<th>CD</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC M8 x 0.75</td>
<td>00122351</td>
<td>PMX 8MF</td>
<td>19.0</td>
<td>19.0</td>
<td>40.0</td>
<td>23</td>
</tr>
<tr>
<td>SC M8 x 1</td>
<td>00122355</td>
<td>PMX 8MC</td>
<td>19.0</td>
<td>19.0</td>
<td>40.0</td>
<td>23</td>
</tr>
<tr>
<td>SC M10 x 1</td>
<td>00122353</td>
<td>TK 10M/PMX 10MF</td>
<td>19.0</td>
<td>19.0</td>
<td>43.0</td>
<td>11</td>
</tr>
<tr>
<td>SC M12 x 1</td>
<td>00122357</td>
<td>PM/PRO 12M</td>
<td>19.0</td>
<td>19.0</td>
<td>40.0</td>
<td>14</td>
</tr>
<tr>
<td>SC M14 x 1,5</td>
<td>00122369</td>
<td>SPM/PM/PRO 25MC</td>
<td>25.4</td>
<td>25.4</td>
<td>31.3</td>
<td>28</td>
</tr>
<tr>
<td>SC M14 x 1</td>
<td>00122366</td>
<td>SPM/PM/PRO 25M</td>
<td>25.4</td>
<td>25.4</td>
<td>25.0</td>
<td>28</td>
</tr>
<tr>
<td>SC M20 x 1,5</td>
<td>00122361</td>
<td>SPM/PM/PRO 50M</td>
<td>38.0</td>
<td>38.0</td>
<td>30.0</td>
<td>43</td>
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<tr>
<td>SC M25 x 1,5</td>
<td>00122362</td>
<td>SPM/PM/PRO 100M</td>
<td>44.5</td>
<td>44.5</td>
<td>38.0</td>
<td>215</td>
</tr>
<tr>
<td>SC M25 x 1,5 x 40</td>
<td>00122363</td>
<td>PRO 110M</td>
<td>50.0</td>
<td>50.0</td>
<td>38.0</td>
<td>215</td>
</tr>
<tr>
<td>SC M25 x 2</td>
<td>00122367</td>
<td>PRO 110MC</td>
<td>44.5</td>
<td>44.5</td>
<td>38.0</td>
<td>215</td>
</tr>
<tr>
<td>SC M27 x 3</td>
<td>00122368</td>
<td>PRO 100MC</td>
<td>44.5</td>
<td>44.5</td>
<td>38.0</td>
<td>215</td>
</tr>
<tr>
<td>SC M33 x 1,5</td>
<td>00122369</td>
<td>PRO 120/220M</td>
<td>41.0</td>
<td>41.0</td>
<td>38.0</td>
<td>210</td>
</tr>
<tr>
<td>SC M36 x 1,5</td>
<td>00122370</td>
<td>PRO 125/250M</td>
<td>63.5</td>
<td>63.5</td>
<td>38.0</td>
<td>210</td>
</tr>
<tr>
<td>SC M45 x 1,5</td>
<td>00122371</td>
<td>PRO 200MC</td>
<td>49.0</td>
<td>49.0</td>
<td>76.0</td>
<td>270</td>
</tr>
<tr>
<td>SC M64 x 2 x 2</td>
<td>00122372</td>
<td>PRO 2050M</td>
<td>89.0</td>
<td>89.0</td>
<td>76.0</td>
<td>475</td>
</tr>
<tr>
<td>SC M64 x 2 x 4</td>
<td>00122373</td>
<td>PRO 2100M</td>
<td>114.0</td>
<td>114.0</td>
<td>76.0</td>
<td>1191</td>
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<tr>
<td>SC M64 x 2 x 6</td>
<td>00122374</td>
<td>PRO 2150M</td>
<td>143.0</td>
<td>143.0</td>
<td>76.0</td>
<td>1475</td>
</tr>
</tbody>
</table>

**URETHANE STRIKER CAP (UC)**

- Hex Jam Nut (not included)

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Part Number</th>
<th>Model (Ref)</th>
<th>A</th>
<th>E1</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC 8609</td>
<td>006040079</td>
<td>PM/PRO 120/125/220/225M</td>
<td>10.0</td>
<td>26.5</td>
<td>3</td>
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<tr>
<td>UC 2940</td>
<td>009400079</td>
<td>PM 1500M</td>
<td>34.5</td>
<td>24.5</td>
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<td>UC 3070</td>
<td>009100079</td>
<td>PM 2000M</td>
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<td>27.0</td>
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<td>UC 5568</td>
<td>005560079</td>
<td>PRO 110M</td>
<td>10.0</td>
<td>22.0</td>
<td>3</td>
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</tbody>
</table>

Note: For complete shock absorber dimension with urethane striker cap, refer to engineering data pages 35-39.

All dimensions in millimeters.
**Non-Adjustable Hydraulic Series Accessories**

**SIDELOAD ADAPTERS (SLA)**

Hex Jam Nut not included.

**UNIVERSAL RETAINING FLANGE (SMALL BORE) (UF)**

USBUM, 10M, TK21/PMX 10M M10 x 1

*Please use special jam nuts only.*

**Notes:**
1. To be used with non-button models only.
2. Maximum sideload angle is 30 degrees.

All dimensions in millimeters.
Non-Adjustable Hydraulic Series Accessories
Clevis Mounting

PM 120 CM(S) ➞ PM 225 CM(S)
PRO 110 CM(S) ➞ PRO 225 CM(S)

<table>
<thead>
<tr>
<th>Catalog No. (Model Ref)</th>
<th>L</th>
<th>M</th>
<th>W</th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>W</th>
<th>X</th>
<th>CR</th>
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</thead>
<tbody>
<tr>
<td>PM/PRO 120 CM(S)</td>
<td>167</td>
<td>6,38</td>
<td>6,38</td>
<td>12,70</td>
<td>12,70</td>
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<td>23</td>
<td>6</td>
<td>12</td>
<td>6,1</td>
<td>11,2</td>
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<tr>
<td>PM/PRO 220 CM(S)</td>
<td>234</td>
<td>6,38</td>
<td>6,38</td>
<td>12,70</td>
<td>12,70</td>
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<td>38</td>
<td>–</td>
<td>23</td>
<td>6</td>
<td>12</td>
<td>6,1</td>
<td>11,2</td>
</tr>
<tr>
<td>PM 1525 CM(S)</td>
<td>199</td>
<td>9,60</td>
<td>12,70</td>
<td>19,00</td>
<td>25,4</td>
<td>12,9</td>
<td>51</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>22</td>
<td>–</td>
<td>14,3</td>
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<tr>
<td>PM 1550 CM(S)</td>
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<td>12,70</td>
<td>19,00</td>
<td>24,4</td>
<td>12,9</td>
<td>51</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>22</td>
<td>–</td>
<td>14,3</td>
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<tr>
<td>PM 1575 CM(S)</td>
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<td>19,00</td>
<td>25,4</td>
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<td>51</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>22</td>
<td>–</td>
<td>14,3</td>
</tr>
<tr>
<td>PM 2050 CM(S)</td>
<td>306</td>
<td>19,07</td>
<td>31,70</td>
<td>38,0</td>
<td>14,0</td>
<td>37,5</td>
<td>73</td>
<td>38</td>
<td>38</td>
<td>35</td>
<td>26</td>
<td>–</td>
<td>23,0</td>
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<tr>
<td>PM 2100 CM(S)</td>
<td>408</td>
<td>19,07</td>
<td>31,70</td>
<td>38,0</td>
<td>14,0</td>
<td>37,5</td>
<td>73</td>
<td>38</td>
<td>38</td>
<td>35</td>
<td>26</td>
<td>–</td>
<td>23,0</td>
</tr>
<tr>
<td>PM 2150 CM(S)</td>
<td>537</td>
<td>19,07</td>
<td>31,70</td>
<td>38,0</td>
<td>14,0</td>
<td>37,5</td>
<td>73</td>
<td>38</td>
<td>38</td>
<td>35</td>
<td>26</td>
<td>–</td>
<td>23,0</td>
</tr>
<tr>
<td>PRO 110 CM(S)</td>
<td>211</td>
<td>5,00</td>
<td>5,00</td>
<td>8,00</td>
<td>8,00</td>
<td>–</td>
<td>28</td>
<td>–</td>
<td>22</td>
<td>11</td>
<td>13</td>
<td>5,0</td>
<td>7,0</td>
</tr>
<tr>
<td>PRO 125 CM(S)</td>
<td>180</td>
<td>6,38</td>
<td>6,38</td>
<td>12,70</td>
<td>12,70</td>
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<td>22</td>
<td>6</td>
<td>24</td>
<td>6,0</td>
<td>11,2</td>
</tr>
<tr>
<td>PRO 225 CM(S)</td>
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<td>6,38</td>
<td>6,38</td>
<td>12,70</td>
<td>12,70</td>
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<td>38</td>
<td>–</td>
<td>22</td>
<td>6</td>
<td>24</td>
<td>6,0</td>
<td>11,2</td>
</tr>
</tbody>
</table>

All dimensions in millimeters.

Note: (S) denotes model available with spring.

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Non-Adjustable Hydraulic Series

Ordering Information

SHOCK ABSORBER ORDERING INFORMATION

Example 1
Standard Products

<table>
<thead>
<tr>
<th>Select quantity</th>
<th>Select catalog number</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>PRO 50 D S B</td>
</tr>
</tbody>
</table>

Select thread designation from engineering data chart (if applicable)
Select damping constant from appropriate sizing graph
Select piston rod type:
- "C" (without button)
- "CM" (Clevis mount)
- "CMS" (Clevis mount with spring)

Example 2
Custom Orifice Products

<table>
<thead>
<tr>
<th>Select quantity</th>
<th>Select catalog number</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>STH .25 M</td>
</tr>
</tbody>
</table>

APPLICATION DATA

Specify:
- Vertical, rotary or horizontal motion
- Weight
- Impact velocity
- Propelling force (if any)
- Other (temperature or other environmental conditions)
- Cycles per hour

*Enidine will specify the individual part number for each application.

ACCESSORIES

Example 1
Universal Mounting Flange

<table>
<thead>
<tr>
<th>Select quantity</th>
<th>Select catalog/part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>UF M10 x 1 (P/N U1 6363 189)</td>
</tr>
</tbody>
</table>

Example 2
Urethane Striker Cap

<table>
<thead>
<tr>
<th>Select quantity</th>
<th>Select catalog/part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>UC 8609 (P/N C98609079)</td>
</tr>
</tbody>
</table>
E
nidine Heavy Duty Series (HD/HDA) large-bore hydraulic shock absorbers protect equipment from large impacts in applications such as automated storage and retrieval systems, as well as overhead bridge and trolley cranes. They are available in a wide variety of stroke lengths and damping characteristics to increase equipment life and meet stringent deceleration requirements.

Features and Benefits

Compact design smoothly and safely decelerates large energy capacity loads up to 1 million Nm per cycle.

Engineered to meet OSHA, AISE, CMMA and other safety specifications such as DIN and FEM.

Internal air charged bladder accumulator replaces mechanical return springs, providing shorter overall length and reduced weight.

Wide variety of optional configurations including bellows, clevis mounts and safety cables.

Available in standard adjustable or custom-orificed non-adjustable models.

Incorporating optional fluids and seal packages can expand standard operating temperature range from (-10°C to 60°C) to (-40°C to 100°C).

All sizes are fully field repairable.

Piston rod extension sensor systems available for reuse safety requirements.

Zinc plated external components provide enhanced corrosion protection. Epoxy painting and special rod materials are available for use in highly corrosive environments.

HD Series
Custom-orificed design accommodates specified damping requirements. Computer generated output performance simulation is used to optimize the orifice configuration. Available in standard bore dimensions of up to 150mm and strokes over 1525mm.

HDA Series
Adjustable units enable user to modify shock absorber resistance to accommodate load velocity variations, with strokes up to 305mm. Standard adjustable configurations available. Special bore sizes and strokes for both HD and HDA Series models are available upon request.

Pages 48-62

<table>
<thead>
<tr>
<th>Catalog No. (Model)</th>
<th>(S) Stroke (mm)</th>
<th>(H) Max. Nm/cycle</th>
<th>Damping Type</th>
<th>Page No.</th>
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<tbody>
<tr>
<td>HD 1.5 x (Stroke)</td>
<td>50-600</td>
<td>50 800</td>
<td>C, E, SC</td>
<td>49</td>
</tr>
<tr>
<td>HD 2.0 x (Stroke)</td>
<td>250-1,400</td>
<td>75 1,000</td>
<td>C, E, SC</td>
<td>50</td>
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<td>HD 3.0 x (Stroke)</td>
<td>50-1,600</td>
<td>135 900</td>
<td>C, E, SC</td>
<td>51-53</td>
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<td>HDA 3.0 x (Stroke)</td>
<td>50-300</td>
<td>37 200</td>
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<td>51</td>
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<td>HD 4.0 x (Stroke)</td>
<td>50-1,600</td>
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<td>C, E, SC</td>
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<td>HDA 4.0 x (Stroke)</td>
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<td>HD 5.0 x (Stroke)</td>
<td>100-1,600</td>
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<td>805 1,000</td>
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<td>HDA 6.0 x (Stroke)</td>
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<td>183 1,000</td>
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<td>59</td>
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Note: Custom orificed HDA shock absorbers available on request.

Stroke size in millimeters, e.g. HD 1.5 x 8 (200mm stroke)
Heavy Duty Large Bore (HD/HDA) Series

Compact, heavy-duty design (non-adjustable shown below) safely and effectively decelerates large moving loads, with energy capacities of up to eight million in-lbs per cycle.

The Enidine HD/HDA Series is a large bore, multi-orifice shock absorber which incorporates a double cylinder arrangement with space between the concentric shock tube and cylinder, and a series of orifice holes drilled down the length of the shock tube wall.

During piston movement, the check ring is seated and oil is forced through the orifices in the shock tube wall, into the gas charged bladder/accumulator area, and behind the piston head. The orifice area decreases as the piston moves and closes the orifice holes. The bladder/accumulator is also compressed by the oil during the compression stroke, which compensates for the fluid displaced by the piston rod during compression.

During repositioning, the pressure from the bladder/accumulator pushes the piston rod outward. This unseats the check ring and permits the oil to flow rapidly through the piston head into the front of the shock tube. The unique gas charged bladder accumulator replaces mechanical return springs, decreasing overall product size and weight.

The HD/HDA Series can provide conventional, progressive or self-compensating damping.

**HD/HDA Series Shock Absorber Sizing**

1. Determine load weight (kg), impact velocity (m/sec), propelling force (N) if any, cycles per hour and stroke (mm) required.
2. Calculate total energy per cycle (Nm/c) and total energy per hour (Nm/hr). Consult this catalog’s sizing section (pages 5-12) for assistance if required.
3. Compare the calculated total energy per cycle (Nm/c) and total energy per hour (Nm/hr), to the values listed in the HD/HDA Series Engineering Data charts. For HDA selection, the impact velocity must be below 3.3 m/sec.
4. Select the appropriate HD/HDA Series model.

**Example: Horizontal Application**

1. Weight (W): 25 000 kg
   Velocity (V): 1.1 m/sec
   Propelling Force (F): 1 500 N
   Cycles/Hour (C): 10 cycles/hr
   Stroke (S): 125mm
2. Total Energy/Cycle (Et): 18 670 Nm/c
   Total Energy/Hour (EtC): 186 700 Nm/hr
3. Compare total energy per cycle (18 670 Nm/c) and total energy per hour (186 700 Nm/hr) to the HD/HDA Series Engineering Data charts (pages 49-60).
4. Selection: HD 3.0 x 5 (HDA is not appropriate because maximum Nm/cycle are exceeded).
Heavy Duty Series

HD Series
HD 1.5 x 2 ~ HD 1.5 x 24

Notes:
1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than these values, a smaller model should be specified.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr.

Notes: For TF, FF and FR mounting, delete front foot and dimensions. ØFC on HD 1.5 foot mount only, is 15mm.

HD SERIES

| Catalog No. (Model) | Base Size (mm) | ØD | ØB | H | ØC | A | F | Y | Z | CB | CC | CA | FB | FE | FG | FJ | CA | CB | CC |
|---------------------|----------------|-----|-----|---|----|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|
| HD 1.5 x 2          | 310            | 90  | 28  | 50 | 508| 20 | 349| 86 | 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 4          | 415            | 90  | 28  | 50 | 708| 20 | 490| 136| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 6          | 514            | 90  | 28  | 50 | 908| 20 | 641| 200| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 8          | 613            | 90  | 28  | 50 | 1,108|20| 792| 280| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 10         | 715            | 90  | 28  | 50 | 1,208|20| 944| 339| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 12         | 817            | 90  | 28  | 50 | 1,308|20| 1,096|390| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 14         | 919            | 90  | 28  | 50 | 1,408|20| 1,248|491| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 16         | 1,021          | 90  | 28  | 50 | 1,508|20| 1,400|591| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 18         | 1,123          | 90  | 28  | 50 | 1,608|20| 1,552|691| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 20         | 1,225          | 90  | 28  | 50 | 1,708|20| 1,704|791| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |
| HD 1.5 x 24         | 1,427          | 90  | 28  | 50 | 1,808|20| 1,856|891| 165| 140| 14  | 122| 32 | 35 | 16  | 144| 56  | 45° |

Note: 1. TB shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than these values, smaller model should be specified.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr.
HD 2.0 x 10 — HD 2.0 x 56

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50% of their maximum rated energy per cycle.

HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than these values, a smaller model should be specified.

It is recommended that the customer consult Enidine for safety-related overhead crane applications.

The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.

Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.

Note: For TF, FF and FR mounting, delete front foot and dimensions.

Catalog No. A B D E F H Y Z
HD 2.0 x 10  757 110 40 60 461 25 481 296 220 178 17 166 40 76 30 184 83 30°
HD 2.0 x 12  895 110 40 60 492 25 532 347 220 178 17 166 40 76 30 194 83 30°
HD 2.0 x 14  999 110 40 60 540 25 583 397 220 178 17 166 40 76 30 194 83 30°
HD 2.0 x 16 1047 110 40 60 594 25 634 448 220 178 17 166 40 76 30 194 83 30°
HD 2.0 x 18 1094 110 40 60 645 25 685 499 220 178 17 166 40 76 30 194 83 30°
HD 2.0 x 20 1001 110 40 60 695 25 735 550 220 178 17 166 40 76 30 194 83 30°
HD 2.0 x 24 1069 110 40 60 797 25 837 602 220 178 17 166 40 76 30 194 83 30°
HD 2.0 x 28 1072 110 40 60 899 25 939 652 220 178 17 166 40 76 30 194 83 30°
HD 2.0 x 32 1051 110 40 60 979 25 1 019 704 220 178 17 166 40 76 30 265 83 30°
HD 2.0 x 36 1072 110 40 60 1 079 25 1 119 755 220 178 17 166 40 76 30 265 83 30°
HD 2.0 x 40 1072 110 40 60 1 179 25 1 219 806 220 178 17 166 40 76 30 265 83 30°
HD 2.0 x 48 1072 110 40 60 1 379 25 1 419 857 220 178 17 166 40 76 30 265 83 30°
HD 2.0 x 56 1072 110 40 60 1 579 25 1 619 908 220 178 17 166 40 76 30 265 83 30°
### Heavy Duty Series

#### HD(A) 3.0 x 2 → HD 3.0 x 18

<table>
<thead>
<tr>
<th>Catalog No. (Model)</th>
<th>Bore Size (mm)</th>
<th>(E) Stroke (mm)</th>
<th>Max. Return Force (N)</th>
<th>Max. Shock Force (N)</th>
<th>Rec. Bolt Size</th>
<th>Rec. Weight (kg)</th>
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<tr>
<td>HD(A) 3.0 x 2</td>
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<td>4 500</td>
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<td>220 500</td>
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<td>HD(A) 3.0 x 3</td>
<td>75 75</td>
<td>10 110</td>
<td>220 500</td>
<td>4 500</td>
<td>220 500</td>
<td>220 500</td>
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<tr>
<td>HD(A) 3.0 x 4</td>
<td>75 75</td>
<td>10 120</td>
<td>220 500</td>
<td>4 500</td>
<td>220 500</td>
<td>220 500</td>
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<td>HD(A) 3.0 x 5</td>
<td>75 75</td>
<td>10 130</td>
<td>220 500</td>
<td>4 500</td>
<td>220 500</td>
<td>220 500</td>
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<tr>
<td>HD(A) 3.0 x 6</td>
<td>75 75</td>
<td>10 140</td>
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<td>HD(A) 3.0 x 8</td>
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<td>HD(A) 3.0 x 9</td>
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<td>HD(A) 3.0 x 11</td>
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<td>4 500</td>
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<td>220 500</td>
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<td>HD 3.0 x 13</td>
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<td>4 500</td>
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<td>220 500</td>
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**Notes:**
1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than these values, a smaller model should be specified.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. HDA models which have an impact velocity below 0.75 m/sec, please contact Enidine for sizing assistance.
6. Maximum cycle rate is 60 cycles/hr.

### Foot Mount Dimensions

<table>
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<tr>
<th>Catalog No. No. (Model)</th>
<th>A</th>
<th>B</th>
<th>D</th>
<th>E</th>
<th>HD</th>
<th>F</th>
<th>H</th>
<th>HD</th>
<th>Y</th>
<th>HD</th>
<th>Z</th>
<th>HDA</th>
<th>X</th>
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</tbody>
</table>

**Notes:**
1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than these values, a smaller model should be specified.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. HDA models which have an impact velocity below 0.75 m/sec, please contact Enidine for sizing assistance.
6. Maximum cycle rate is 60 cycles/hr.

All dimensions in millimeters.

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HD SERIES

HD 3.0 x 20 → HD 3.0 x 56

Note: For TF, FF and FR mounting, delete front foot and dimensions.

<table>
<thead>
<tr>
<th>Catalog No. (Model)</th>
<th>Bore Size (mm)</th>
<th>ØD Strips (mm)</th>
<th>(ØD) Max. Shock Force (N)</th>
<th>(H) Max. Stroke Force (Nm/cycle)</th>
<th>ØFC</th>
<th>Flange Dimensions</th>
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<td>HD 3.0 x 20</td>
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<td>500</td>
<td>75</td>
<td>500</td>
<td>92</td>
<td>350 Nm/hour</td>
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<td>HD 3.0 x 32</td>
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<td>350 Nm/hour</td>
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<td>HD 3.0 x 36</td>
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<td>1422</td>
<td>75</td>
<td>1422</td>
<td>270</td>
<td>350 Nm/hour</td>
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</tbody>
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Notes:
1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr.

---

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Heavy Duty Series

HD 3.5 x 2 — HD 3.5 x 16

Charge Port

Flange Dimensions

Notes:
1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr.

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---

Catalog No. (Model)  Bore Size (mm)  Stroke (mm)  Max. Force Nm/cycle  Max. Return Force Nm/hour  Max. Shock Force N (N)  Flange Dimensions

HD 3.5 x 2  80  50  12,750  3,000,000  300,000  860  200  180  HD030  32
HD 3.5 x 4  80  100  25,500  6,000,000  300,000  860  200  180  HD060  37
HD 3.5 x 6  80  150  38,250  9,000,000  300,000  860  200  180  HD090  42
HD 3.5 x 8  80  200  51,000  12,000,000  300,000  860  200  180  HD120  47
HD 3.5 x 10  80  250  63,750  15,000,000  300,000  860  200  180  HD150  52
HD 3.5 x 12  80  300  76,500  18,000,000  300,000  860  200  180  HD180  57
HD 3.5 x 16  80  400  102,000  25,000,000  300,000  860  200  180  HD250  62

Catalog No. (Model)  A  B  D  E  F  H  Y  Z  Max. Return Force Nm  Flange Dimensions

HD 3.5 x 2  254  155  56  82  35  25  284  35  300  225  27  300  110  25  139  86  90°
HD 3.5 x 4  456  155  56  82  205  25  395  106  300  225  27  300  110  25  139  86  90°
HD 3.5 x 6  556  155  56  82  315  25  985  186  300  225  27  300  110  25  139  86  90°
HD 3.5 x 8  658  155  56  82  446  25  496  237  300  225  27  300  110  25  139  86  90°
HD 3.5 x 10  760  155  56  82  647  25  497  288  300  225  27  300  110  25  139  86  90°
HD 3.5 x 12  862  155  56  82  498  25  548  359  300  225  27  300  110  25  139  86  90°
HD 3.5 x 16  964  155  56  82  399  25  640  480  300  225  27  300  110  25  139  86  90°

Note: øFC on HD 3.5 flange only is 22mm.
HD 3.5 x 20 → HD 3.5 x 48

Catalog No. (Model) | Bore Size (mm) | Stroke (mm) | Max. Return Force (N) | Max. Shock Force (N) | Weight (kg)
--- | --- | --- | --- | --- | ---
HD 3.5 x 20 | 80 | 500 | 600,000 | 300,000 | 860
HD 3.5 x 24 | 80 | 600 | 700,000 | 350,000 | 910
HD 3.5 x 28 | 80 | 700 | 800,000 | 400,000 | 960
HD 3.5 x 32 | 80 | 800 | 900,000 | 450,000 | 1010
HD 3.5 x 36 | 80 | 900 | 1,000,000 | 500,000 | 1060
HD 3.5 x 40 | 80 | 1,000 | 1,100,000 | 550,000 | 1110
HD 3.5 x 48 | 80 | 1,200 | 1,300,000 | 600,000 | 1170

Notes:
1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr.

All dimensions in millimeters.
Heavy Duty Series

HD/HDA Series

HD(A) 4.0 x 2 → HD 4.0 x 16

Notes:
1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than these values, a smaller model should be specified.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. HDA models which have an impact velocity below 0.75 m/sec, please contact Enidine for sizing assistance.
6. Maximum cycle rate is 60 cycles/hr.

All dimensions in millimeters.

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>(Model)</th>
<th>FA</th>
<th>FB</th>
<th>FC</th>
<th>FD</th>
<th>FE</th>
<th>FG</th>
<th>FJ</th>
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HD models will function satisfactorily at 10% of their maximum rated energy per cycle. If less than these values, a smaller model should be specified.

HD series models which have an impact velocity below 0.75 m/sec, please contact Enidine for sizing assistance.

Maximum cycle rate is 60 cycles/hr.
## Heavy Duty Series

### HD 4.0 x 20 → HD 4.0 x 48

#### Charge Port

#### Fill Port

**Note:** For TF, FF and FR mounting, delete front foot and dimensions.

### Charge Port Dimensions

All dimensions in millimeters.

<table>
<thead>
<tr>
<th>Catalog No. (Model)</th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>D (mm)</th>
<th>E (mm)</th>
<th>F (mm)</th>
<th>H (mm)</th>
<th>Y (mm)</th>
<th>Z (mm)</th>
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<th>FB (mm)</th>
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<th>FE (mm)</th>
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**Notes:**
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5. Maximum cycle rate is 60 cycles/hr.
Heavy Duty Series

HD(A) 5.0 x 4 → HD(A) 5.0 x 12

### HD/HDA Series

**Charge Port Dimensions**

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<th>HDA</th>
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<td>( Z )</td>
<td>( H )</td>
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<td>( F )</td>
<td>( A )</td>
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**Flange Dimensions**

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<th>FE</th>
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<th>FJ</th>
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<td>125</td>
<td>578</td>
<td>588</td>
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</table>

**Notes:**

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6. HDA models which have an impact velocity below 0.75 m/sec, please contact Enidine for sizing assistance.
7. Maximum cycle rate is 60 cycles/hr.

### Foot Mount Dimensions

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<th>H</th>
<th>HD</th>
<th>Y</th>
<th>HD</th>
<th>Z</th>
<th>Model</th>
<th>Weight (kg)</th>
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<tr>
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HD 5.0 x 16 → HD 5.0 x 48

**Heavy Duty Series**

**HD Series**

**Charge Port**

**Fill Port**

**HD SERIES**

---

**Note:** For TF, FF and FR mounting, delete front foot and dimensions.

---

### Catalog No. (Model)

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<th>Catalog No.</th>
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<th>(B) Max.</th>
<th>Max.</th>
<th>Max. Shock Force (N)</th>
<th>Max. Return Force (N)</th>
<th>Max. Return Force (Nm/hour)</th>
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### Foot Mount Dimensions

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### Charge Port Dimensions

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</tbody>
</table>

---

**Note:**
1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle.
2. For TF, FF and FR mounting, delete front foot and dimensions.
3. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
4. Rear-flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr.
### Heavy Duty Series (HD) 6.0 x 4 → HD 6.0 x 48

#### HD Series

- **HD(A) 6.0 x 4**
  - **HD**
  - **HDA**
  - **HD**
  - **HDA**
  - **HD**
  - **HDA**
  - **HD**
  - **HDA**

#### HD HDA Series

- **Catalog No.**
- **Model**
- **Size (mm)**
- **Stroke (mm)**
- **Max. Shock Force (N) at 5% of Max. Energy per Cycle**
- **Max. Max. Energy per Cycle (Nm/cycle)**
- **Max. Max. Energy per Hour (Nm/hour)**
- **Bolt Size (SA)**
- **Weight (kg)**

<table>
<thead>
<tr>
<th>HD(A) 6.0 x 4</th>
<th>160</th>
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#### Notes

1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than these values, a smaller model should be specified.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 300mm strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
## HD Series

**Cylindrical Clevis Dimensions**

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<th>Model</th>
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<th>B</th>
<th>D</th>
<th>E</th>
<th>H</th>
<th>F</th>
<th>CA</th>
<th>CB</th>
<th>CC</th>
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<th>CE</th>
<th>CF</th>
<th>FA</th>
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</table>

All dimensions in mm/Inches.
After properly sizing an HDA shock absorber, the usable range of adjustment settings can be determined:

1. Locate the intersection point of the application’s impact velocity and the HDA model graph line.
2. The intersection is the maximum adjustment setting to be used. Adjustments exceeding this setting could overload the shock absorber.
3. The usable adjustment setting range is from setting 1 to the MAXIMUM adjustment setting as determined in step 2.

**EXAMPLE: HDA**
1. Impact velocity: 2.00 m/sec
2. Intersection point: Adjustment setting 3
3. Usable adjustment setting range: 1 to 3

**Damping Force**
Position 1 provides minimum damping force, Position 5 provides maximum damping force.

**Useable Adjustment Setting Range**

**Optional Piston Rod Return Sensor**
- Magnetic proximity sensor indicates complete piston rod return with 3m long cable.
- If complete piston rod does not return the circuit remains open. This can be used to trigger a system shut-off.
- Contact Enidine for other available sensor types.

**Sensor Specifications**

- Magnetic proximity sensor indicates complete piston rod return with 3m long cable.
- If complete piston rod does not return the circuit remains open. This can be used to trigger a system shut-off.
- Contact Enidine for other available sensor types.
Typical mounting methods are shown below. Special mounting requirements can be accommodated upon request.

**TM: Rear Flange Front Foot Mount**

**FM: Front and Rear Foot Mount**
Also shown is optional safety cable, typically used in overhead applications.

**TF: Front and Rear Flanges**

**FF: Front Flange**

**CJ: Clevis Mount**

**FR: Rear Flange**
Note: Rear flange mounting not recommended for stroke lengths above 300mm

---

**HD/HDA Ordering Information**

**Example:**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>HD 3.0 x 5</th>
<th>TM</th>
<th>C Options</th>
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<tr>
<td>4</td>
<td></td>
<td>TM (Rear flange front foot mount)</td>
<td>C (Sensor)</td>
</tr>
</tbody>
</table>

**APPLICATION DATA**
Specify for HD models only
- Vertical or horizontal motion
- Weight
- Impact velocity
- Propelling force (if any)
- Options
- Other (temperature or other environmental conditions, safety standards, etc.)
Enidine’s Heavy Industry (HI) Series buffers safely protect heavy machinery and equipment during the transfer of materials and movement of products. The large-bore, high-capacity buffers are individually designed to decelerate moving loads under various conditions and in compliance with industry mandated safety standards. Control of bridge cranes, trolley platforms, large container transfer and transportation safety stops are typical installations. Industry-proven design technologies, coupled with the experience of a globally installed product base, ensure deliverable performance that exceeds customer expectations.

The oversize bore area results in optimal energy absorption capabilities and increased internal safety factors. State-of-the-art testing facilities ensure integrity of design and product performance.

**Features and Benefits**

- Compact design smoothly and safely decelerates large energy capacity loads up to 500 kNm per cycle with standard stroke lengths.
- Engineered to meet OSHA, AISE, CMMA and other safety specifications such as DIN and FEM.
- Nitrogen-charged return system allows for soft deceleration and positive return in a maintenance-free package.
- Wide variety of optional configurations including protective bellows and safety cables.
- Available in custom-orificed non-adjustable models.
- Incorporating optional fluids and seal packages available to expand standard operating temperature range from (-20°C to 80°C) to (-30°C to 80°C).
- Surface treatment (Sea water resistant) Housing: gray color-three part epoxy
  Piston Rod: hard-chrome plated steel
- Special epoxy painting and rod materials are available for use in highly corrosive environments.

HI Series buffer models can decelerate loads with varying velocities from 0.15 m/sec to 5.0 m/sec.

All models are custom-orificed for specific application requirements.

**Pages 64-66**
Enidine’s Heavy Industry Series (HI) buffers safely protect heavy machinery and equipment during the transfer of materials and movement of products. The large-bore, high-capacity buffers are individually designed to decelerate moving loads under various conditions and in compliance with industry mandated safety standards. Control of bridge cranes, trolley platforms, large container transfer and transportation safety stops are typical installation examples. Industry-proven design technologies, coupled with the experience of a globally installed product base, ensure deliverable performance that exceeds customer expectations.

Prior to HI Series buffer manufacture, computer-simulated response curves are generated to model actual conditions, verify product performance, confirm damping characteristics and generate unique custom-orificed designs that accommodate multi-condition or specific damping requirements.

Characteristics of the HI Series include a nitrogen-charged return system that allows for soft deceleration and positive return in a maintenance-free package. The oversize bore area results in optimal energy absorption capabilities and increased internal safety factors. State-of-the-art testing facilities ensure integrity of design and product performance.

**Design Overview**

The HI Series buffer design incorporates the proven damping system of multiple orifice patterns drilled down the shock tube length, for precise deceleration profiles, coupled with a nitrogen return system for controlled extension of the piston rod to its original position.

During piston movement, oil is forced through the orifice pattern into the oil reservoir chamber. This controlled movement of a piston head by decreasing the orifice area results in precise decay of impact velocity and safe deceleration of the moving load. The oil volume evacuated from the high pressure chamber moves the separating piston, compensating for the oil differential within the unit.

Extension of the piston rod for the next impact is accomplished by the force created from the compressed nitrogen chamber, which acts as both a oil volume compensator and return force mechanism. The pressure created pushes the fluid back into the oil chamber and creates a force to reposition the piston rod to the fully extended position, ready for the next impact sequence. The nitrogen return system enables the HI Series to be designed for the maximum energy absorption within the smallest envelope size.
## Heavy Industry (HI) Series

### HI Series

### HI 100 x 50 → HI 120 x 1000

<table>
<thead>
<tr>
<th>Model</th>
<th>Stroke (mm)</th>
<th>Max. Energy/cycle (kJ/Mm)</th>
<th>Max. Shock force (kN)</th>
<th>Return Force</th>
<th>Weight (kg)</th>
<th>A₁</th>
<th>A₂</th>
<th>Z</th>
<th>H</th>
<th>ØB</th>
<th>SA</th>
<th>SB</th>
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All dimensions in millimeters.
**Heavy Industry (HI) Series**

**HI 130 x 250 → HI 150 x 1000**

---

**HI Series Ordering Information**

Mounting bracket flange: Standard: Rear or Front mount

**Example:**

4 **HI 120 x 100**

Select quantity  Select HI Series model from Engineering Data Chart

Select mounting method  • FF (Flange Front)  • FR (Flange Rear)

Additional Options  • B Protective Bellows  • C Safety cable

**APPLICATION DATA**

Required for all models:

- Vertical/Horizontal Motion
- Weight
- Impact Velocity
- Propelling Force (if any)
- Cycles/Hour
- Temperature/Environment
- Applicable Standards

---

**HI Series**

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<th>Model</th>
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<th>Max. Energy/Stroke (kNm)</th>
<th>Max. Shock Force (kN)</th>
<th>Return Force</th>
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<th>Compression (mm)</th>
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All dimensions in millimeters.
Enidine Rate Controls are designed to regulate the speed and time required for a mechanism to move from one position to another. Adjustable and non-adjustable models are available to accommodate a wide variety of motion control applications. Both single and double acting hydraulic damper designs allow smooth, controllable machine operation by providing rate control for both linear and rotational (hinged) loads. Each product family offers a variety of stroke lengths from which to choose.

Features and Benefits

- Extensive product line offers flexibility in both size and load capacities to fulfill a wide range of application requirements.
- ISO quality standards result in reliable, long-life operation.
- A select variety of surface finishes maintains the original quality appearance and provides the longest corrosion resistance protection.
- Custom stroke lengths and damping characteristics can be designed to suit your application requirements.
- Incorporating optional fluids can expand the standard operational temperature range from (–10°C to 80°C) to (–30°C to 100°C).
- Special materials and finishes available to meet specific customer requirements.

These Adjustable, Double Acting (ADA 500M and ADA 700M Series) rate controls regulate speed in both tension and/or compression modes independently. ADA products let the user adjust the rate to suit specific application requirements. Fixed orifice interchangeable cartridges are available for the ADA 500M Series which provide tamperproof operation once the desired rate has been determined. An optional remote adjustment cable provides adjustment control in otherwise inaccessible locations for the ADA 500M Series.

Pages 71-75

The DA Series are non-adjustable, custom-orificed at factory, double acting rate controls which provide smooth, reliable motion control for high load capacities.

Page 76
Rate Controls

Use this Enidine Product Selection Guide to quickly locate potential rate control models most suited for your requirements.

### ADJUSTABLE RATE CONTROLS

<table>
<thead>
<tr>
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### NON-ADJUSTABLE RATE CONTROLS

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Rate Controls Sizing

1. Determine the damping direction (tension [T], compression [C] or both [T and C]), stroke (mm) required, propelling force (N), desired velocity (mm/sec) and cycles per hour.
2. Calculate total energy per hour (Nm/hr).
3. Compare the damping direction, stroke (mm) required, propelling force (N) and total energy per hour (Nm/hr) to the values listed in the Rate Control Series Engineering Data charts.
   NOTE: Propelling force and velocity should be measured at the location of the rate control.
4. Select the appropriate rate control model.
   a. For adjustable rate control models, refer to the Useable Adjustment Settings section for the selected model to determine the proper adjustment setting.
   b. For non-adjustable rate control models, refer to the Damping Constant Selection Instructions for the selected model to determine the proper damping constant.

Example:

1. Damping Direction (T, C or T and C): T and C
   Stroke (S): 100mm
   Propelling Force (FD): 900 N (T and C)
   Velocity (V): 200mm/sec
   Cycles/Hour (C): 20
2. Total Energy/Hour (Nm/hr): 1 800 Nm/hr compression
   1 800 Nm/hr tension
   3 600 Nm/hr Total
3. Compare damping direction (T and C), stroke (100mm), propelling force (900 N) and total energy per hour (3 600 Nm/hr) to the values listed in the rate control series engineering data charts on pages 71-76.
4. Selection: ADA 510M TC
   The proper adjustment is 2 in tension and compression per the ADA 500M Series Useable Adjustment Setting Range Curves (refer to page 72).
Enidine Rate Controls are used to regulate the speed or time required for a mechanism to move from one position to another. They use proven technology to enhance performance in a variety of product applications. Rate controls are typically used to control pneumatic cylinders, linear slides, lids, and other moving mechanisms.

The advantages of using rate controls include:

1. **Longer Machine Life** – The use of rate controls significantly reduces shock and vibration to machinery caused by uncontrolled machine operation. This further reduces machinery damage, downtime and maintenance cost, while increasing machine life.

2. **Improved Production Quality** – Harmful effects of uncontrolled motion, such as noise, vibration and damaging impacts, are moderated or eliminated so that production quality is improved.

3. **Safer Machinery Operation** – Rate controls protect machinery and equipment operators by offering predictable, reliable and controlled machine operation.

4. **Competitive Advantage** – Machines and end products become more valuable because of increased productivity, longer life, lower maintenance and safer operation.

Enidine offers a wide range of rate controls that provide motion control in tension, compression, or both directions. Adjustable and non-adjustable tamperproof models are available to fit your particular application requirements.

The resisting force provided by Enidine rate controls is typically constant over the entire stroke when the piston rod is moved at a constant velocity, since the rate controls are single orifice products. DA Series models (see page 76) can be custom orificed to provide increasing resisting force over the stroke through the use of multiple orifices in the shock tube. This can be beneficial when controlling the velocity of a lid as it closes, since the torque from the weight of the lid changes as it closes.

**Rate Control Adjustment Techniques**

A properly adjusted rate control safely controls machinery operation, and reduces noise levels from uncontrolled motion. To correctly adjust the rate control after it has been properly sized for the application, set the adjustment knob (per the useable adjustment setting graphs on pages 72 and 75) for the applicable model. Cycle the mechanism and observe the motion of the system.

If the motion of the mechanism is too fast, move the adjustment dial to the next largest number until the desired velocity is achieved.

If the motion of the mechanism is too slow, move the adjustment dial to the next smallest number until the desired velocity is achieved.

**Selecting the Proper Enidine Rate Control**

1. When sizing a rate control, determine the velocity and drive force at the rate control.

2. Do not bottom the rate control in tension or compression. Provide an external positive stop.

3. Environment (ambient temperature, corrosive conditions, etc.) must be considered.

4. When both tension and compression rate control are required, select an ADA or DA model, which can accommodate your specific application requirement.

5. For hard-to-reach applications which require adjustment, a remote adjustment cable is available with the ADA 500M Series.
Adjustable, Double Acting (ADA Series) Rate Controls

Endine Double Acting Adjustable (ADA) rate controls control the velocity of both linear and rotational loads throughout their entire motion. Adjustment cartridges on the ADA 500M Series allow flexibility in controlling the speed for an applied force in both tension and compression directions. Maximum damping is achieved by turning the adjustment knob to the number eight (8) setting, while turning the knob to the zero (0) setting provides minimal resistance. Interchangeable, threaded, fixed-orifice cartridges can provide consistent, tamper-resistant damping to meet particular application requirements.

The ADA 500M Series utilizes two independent adjustment cartridges for motion control in each direction, housed in the cylinder end. The ADA 700M Series has independently controlled tension and compression capabilities located at each end of the unit.

Resistance is controlled by using a wrench key at either end of the rate control and adjusting the movement by following the stiffer (+) or softer (-) indications. When the rate control is compressed, the oil is orificed through the compression adjustment cartridge and flows freely through the tension adjustment cartridge. The tension cartridge check ball unseats and allows free flow of the oil to the rod end of the shock tube. A foam accumulator is utilized to accept the volume of oil displaced by the piston rod. When the rate control is extended, oil is moved through an internal flow path in the shock tube and is orificed through the tension adjustment cartridge. The compression cartridge check ball unseats and allows free flow of the oil into the blind end of the shock tube.

Non-Adjustable, Double Acting (DA Series) Rate Controls

DA Series rate controls are ideally suited for high-energy, heavy load applications requiring rate control in tension, compression or both directions. These non-adjustable, custom-orificed units are designed to specific input conditions, and allow for single and multiple orifice configurations.

Upon compression of the rate control, the compression check ball seats. As the piston head moves, oil is forced through the orifice hole(s) located in the shock tube, producing the required damping force. After the oil has passed through the orifice hole(s), a portion of the oil passes through the extension check valve and fills the rod end of the shock tube. The remainder of the oil volume displaced by the piston rod compresses the foam accumulator.

Upon extension of the rate control, the extension check ball seats. As the piston head moves, oil is forced through the orifice hole(s) located in the shock tube producing the required damping force. The compression check ball is unseated by the flow of oil which fills the blind end of the shock tube.
### Rate Controls

**ADA 500M Series**

**ADA 505M → ADA 525M**

---

#### Dimensions

![Dimension Diagram](image)

- **C**: Stroke Diameter
- **D**: Diameter of Stroke
- **F**: Hole Diameter
- **L**: Length
- **ON**: Offset

#### Specifications

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#### Shock Cover

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<td>14.2</td>
<td>9.5</td>
</tr>
<tr>
<td>ADA 510M</td>
<td>27.0</td>
<td>8.0</td>
<td>225.0</td>
<td>250.0</td>
<td>6.0</td>
<td>20.0</td>
<td>32.7</td>
<td>6.3</td>
<td>14.2</td>
<td>9.5</td>
</tr>
<tr>
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<td>27.0</td>
<td>8.0</td>
<td>175.0</td>
<td>200.0</td>
<td>6.0</td>
<td>20.0</td>
<td>32.7</td>
<td>6.3</td>
<td>14.2</td>
<td>9.5</td>
</tr>
<tr>
<td>ADA 520M</td>
<td>27.0</td>
<td>8.0</td>
<td>125.0</td>
<td>150.0</td>
<td>6.0</td>
<td>20.0</td>
<td>32.7</td>
<td>6.3</td>
<td>14.2</td>
<td>9.5</td>
</tr>
</tbody>
</table>

---

**Note:** All dimensions in millimeters.
Rate Controls

ADA 500M Series

EXAMPLE: Double Acting Application

Stroke required: 50mm
Control direction: Tension and Compression
Propelling force: 1,750 N (tension), 1,750 N (compression)
Selection: ADA 505M

1. Velocity: 300mm/sec (tension), 150mm/sec (compression)
Intersection point: Adjustment setting 2 (tension), 4 (compression)

2. Adjustement setting: 2 (tension), 4 (compression)
Velocity: 300mm/sec (tension), 150mm/sec (compression)

NOTE: Propelling force and velocity should be measured at the location of the rate control.

After properly sizing the ADA as described on page 68, the adjustment setting can be determined.
Enidine will custom fit a remote adjustment cable for applications where the ADA unit will be mounted in non-accessible locations. Contact Enidine for more information.

Standard remote adjustment cable length is 1200mm. Optional lengths available upon request. Note: Remote adjustment cable can be used in a single position only.

Remote Adjustment Cable

Note: If rotary application, please complete application worksheet on page 81 and forward to Enidine.

Catalog No. | Part Number | Accessory Description | LA | Weight (g)
--- | --- | --- | --- | ---
RAC48 | 1K495748 | Remote Adjustment Cable | 1220 | 191
RAC4957 | AJ495735 | Adjustable Cartridge | | |
NAC “x” | NJ x 9557327 | Non-Adjustable Cartridge (0-6) | | |
CW4957 | 2L4957302 | Cartridge Wrench | | |
FPP4957 | PA4957326 | Free Flow Plug | | |

Adjustable Cartridge | Free Flow Plug | Non-Adjustable Cartridge

*Note: Remote adjustment setting (from Adjustment Setting Curve[s]) to be duplicated in non-adjustable cartridge.
<table>
<thead>
<tr>
<th>Catalog No. (Model)</th>
<th>Damping Direction</th>
<th>Bore Size (mm)</th>
<th>(S) Stroke (mm)</th>
<th>Rate Control Max Propelling Force</th>
<th>Tension (N)</th>
<th>Compression (N)</th>
<th>Max Weight Nm/hour</th>
<th>Max Weight (kg)</th>
<th>Model Weight (kg)</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADA 705M T, C or T and C</td>
<td>25.0</td>
<td>50.0</td>
<td>10,000</td>
<td>10,000</td>
<td>154,000</td>
<td>2.0</td>
<td>339</td>
<td>237</td>
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<tr>
<td>ADA 710M T, C or T and C</td>
<td>25.0</td>
<td>100.0</td>
<td>11,000</td>
<td>11,000</td>
<td>206,000</td>
<td>2.3</td>
<td>441</td>
<td>292</td>
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<tr>
<td>ADA 715M T, C or T and C</td>
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<td>150.0</td>
<td>11,000</td>
<td>11,000</td>
<td>247,000</td>
<td>2.6</td>
<td>541</td>
<td>332</td>
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<tr>
<td>ADA 720M T, C or T and C</td>
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<td>11,000</td>
<td>11,000</td>
<td>288,000</td>
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<td>643</td>
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<tr>
<td>ADA 725M T, C or T and C</td>
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<td>250.0</td>
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<td>11,000</td>
<td>328,000</td>
<td>3.2</td>
<td>745</td>
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<td></td>
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<td>ADA 730M T, C or T and C</td>
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<td>300.0</td>
<td>11,000</td>
<td>11,000</td>
<td>368,000</td>
<td>3.6</td>
<td>847</td>
<td>485</td>
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<td></td>
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<tr>
<td>ADA 735M T, C or T and C</td>
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<td>350.0</td>
<td>11,000</td>
<td>11,000</td>
<td>408,000</td>
<td>3.9</td>
<td>949</td>
<td>535</td>
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<tr>
<td>ADA 740M T, C or T and C</td>
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<td>400.0</td>
<td>11,000</td>
<td>11,000</td>
<td>448,000</td>
<td>4.2</td>
<td>1,049</td>
<td>586</td>
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<td>ADA 745M T, C or T and C</td>
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<td>450.0</td>
<td>11,000</td>
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<td>488,000</td>
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<td>ADA 750M T, C or T and C</td>
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<td>500.0</td>
<td>11,000</td>
<td>11,000</td>
<td>528,000</td>
<td>4.8</td>
<td>1,253</td>
<td>688</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ADA 755M T, C or T and C</td>
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<td>550.0</td>
<td>11,000</td>
<td>11,000</td>
<td>568,000</td>
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<td>1,355</td>
<td>739</td>
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<tr>
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<td>600.0</td>
<td>11,000</td>
<td>11,000</td>
<td>608,000</td>
<td>5.5</td>
<td>1,457</td>
<td>790</td>
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<td></td>
<td></td>
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<td>ADA 765M T, C or T and C</td>
<td>25.0</td>
<td>650.0</td>
<td>11,000</td>
<td>11,000</td>
<td>648,000</td>
<td>5.8</td>
<td>1,559</td>
<td>840</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ADA 770M T, C or T and C</td>
<td>25.0</td>
<td>700.0</td>
<td>11,000</td>
<td>11,000</td>
<td>688,000</td>
<td>6.1</td>
<td>1,661</td>
<td>891</td>
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<td></td>
<td></td>
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<td>750.0</td>
<td>11,000</td>
<td>11,000</td>
<td>728,000</td>
<td>6.5</td>
<td>1,763</td>
<td>942</td>
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<td></td>
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<tr>
<td>ADA 780M T, C or T and C</td>
<td>25.0</td>
<td>800.0</td>
<td>11,000</td>
<td>11,000</td>
<td>768,000</td>
<td>6.8</td>
<td>1,865</td>
<td>993</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: The maximum load capacity for mounting option D is 1600 N.

All dimensions in millimeters.
**Rate Controls**

**ADA 700M Series**

**Useable Adjustment Setting Range**

Red lines are model’s maximum allowable propelling force.

---

**Damping Force**

1. To determine the approximate adjustment setting, when the selected model, propelling force, and velocity are known: compare velocity to the propelling force in the compression and/or tension mode adjustment setting curves. The intersection point of the velocity and the propelling force is the approximate adjustment setting to be used. Adjustment lower or higher than this setting will result in slower or faster damper operation respectively.

2. To determine the velocity, when the selected model, adjustment setting, and propelling force are known: compare the propelling force to the adjustment setting in the compression and/or tension mode adjustment setting curves. The intersection point of the propelling force and the adjustment setting is the approximate velocity for the selected model. Higher velocities are obtained at higher adjustment settings and lower velocities are obtained at lower adjustment settings.

3. A 1.5mm Hex Wrench (Provided) is required to adjust the unit.

**NOTE:** When a free flow plug is used, the intersection point of the propelling force and free flow plug curve determines the velocity.

**EXAMPLE:** Adjustable Double Acting Rate Control Application

Stroke required: 150mm
Propelling force: 6 000 N (tension), 1 500 N (compression)
Selection: ADA 715M

1. Velocity requested: 0.65 m/sec (tension), 0.1 m/sec (compression)

2. Adjustment setting
   Composition: 3/4 turns opened,
   Tension: 1 1/4 turns opened

**NOTE:** Propelling force and velocity should be measured at the location of the rate control.

---

**ADA 700M Ordering Information**

**Example:**

<table>
<thead>
<tr>
<th>Select quantity</th>
<th>ADA 770M</th>
<th>T</th>
<th>C</th>
<th>B</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tension Mode:</td>
<td>A: Clevis</td>
<td>B: Swivel Bearing</td>
<td>C: Fork</td>
<td>D: Knee Joint</td>
<td>G: Threaded Only</td>
</tr>
<tr>
<td>Adjustable (P = Free Flow)</td>
<td>(P = Free Flow)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Internet:** [www.enidine.de](http://www.enidine.de)  **Phone:** +49 (0) 7635 8101 0  **Fax:** +49 (0) 7635 8101 99
Rate Controls

DA Series

Catalog No. (Model) | Damping Direction | Bore Size (mm) | ØD Stroke (mm) | Fl. Max. Propelling Force (N) | Fl. Max. Min./cycle | ØB Max. Min./hour | Model Weight (kg)
--- | --- | --- | --- | --- | --- | --- | ---
DA 75M x 50 | L or T and C | ØM 38.0 | ØD 50.0 | ØD 22,500 | 5,700 | 305,000 | 11.4
DA 75M x 100 | L or T and C | 38.0 | 100.0 | 22,500 | 3,240 | 320,000 | 13.2
DA 75M x 150 | L or T and C | 38.0 | 150.0 | 22,500 | 3,560 | 400,000 | 15.0
DA 75M x 200 | L or T and C | 38.0 | 200.0 | 22,500 | 4,400 | 480,000 | 16.8
DA 75M x 250 | L or T and C | 38.0 | 250.0 | 22,500 | 5,600 | 560,000 | 18.6

Notes:
1. DA Models will function at 10% of their maximum rated energy per cycle. If less than 10%, a smaller model should be specified.
2. Provide a positive stop 3mm before end of stroke in tension and compression to prevent internal bottoming.
3. For optimal performance in vertical applications using compression, mount the rate control with the piston rod down.

All dimensions in millimeters.

Catalog No. Damping Bore Size Stroke Max. Propelling Max. Max. Model Weight (kg)
--- | --- | --- | --- | --- | ---
DA 75M x 50 | T, C or T and C | ØM 38.0 | ØD 50.0 | 22,500 | 22 | 250 | 1 | 120 | 305,000 | 11.4
DA 75M x 100 | T, C or T and C | 38.0 | 100.0 | 22,500 | 22 | 250 | 2 | 240 | 320,000 | 13.2
DA 75M x 150 | T, C or T and C | 38.0 | 150.0 | 22,500 | 22 | 250 | 3 | 360 | 400,000 | 15.0
DA 75M x 200 | T, C or T and C | 38.0 | 200.0 | 22,500 | 22 | 250 | 4 | 480 | 480,000 | 16.8
DA 75M x 250 | T, C or T and C | 38.0 | 250.0 | 22,500 | 22 | 250 | 5 | 600 | 560,000 | 18.6

DA Model Sizing and Ordering Information

All DA Models are custom orificed. Application data must be supplied when ordering (see application worksheet, page 81)

Please provide all application data for unique part number assignment.

Example: Select quantity

Select Catalog No. from Engineering Data chart

Specify for damping in tension, compression or both, as applicable:
- Vertical, Horizontal or Rotary Motion
- Propelling Force
- Other (temperature, environmental conditions, etc.)
- Velocity
- Cycles Per Hour
- Weight

NOTE: Propelling force and velocity should be measured at the location of the rate control.
Application Examples

The following are examples of shock absorber and rate control applications:

**AUTOMOTIVE – ROBOTICS**
Low Range OEM shock absorbers, mounted close to the pivot point of body side assembly robots, control high drive forces for precise robot positioning and improved assembled product quality.

**GLASS FORMING EQUIPMENT**
A single OEM adjustable shock absorber replaces three distinct non-adjustable units, to cushion the high velocity motion of the take out-out, take out-in, and blow head positions of a glass forming machine. The single unit simplifies installation, reduces inventory costs and improves machine uptime.

**FOUNDRY – CONVEYOR LINE**
An OEM shock absorber smoothly decelerates metal flasks traveling on a conveyor line, eliminating damage to flasks and decreasing foundry scrap caused by mold defects.

**MANUFACTURING FACILITY – RAIL CARTS**
OEM Low Profile shock absorbers offer smooth, steady resistance that prevents assembly carts from over-traveling endstops, while also protecting transported goods from potential damage.

**PALLET STOP**
An OEM model, used in conjunction with a pallet stop, smoothly decelerates and precisely positions assembled parts as they move to various production stations on a motorized conveyor system.

**AIR CYLINDER**
As air cylinders operate at higher velocities and with increased loads, the cylinder cushion becomes ineffective. An OEM Model with BAC package is needed to accommodate high impact forces, allow quieter operation, increase production rates and extend cylinder life.

**ROLLING DOOR**
As automatic rolling doors open and close, OEM models are used for linear deceleration to decrease noise, protect precision mechanical components and prolong door life.

**CAT SCAN EQUIPMENT**
OEM Models assist with deceleration and protection of the delicate CAT scan camera during start/stop patient scanning procedures.
**Application Examples**

**PRINTING**
An OEM large shock absorber assists in paper positioning and prevents equipment damage during printing press test runs (when the press is stopped frequently to confirm proper colors, focus and paper position).

**PAPER ROLLS**
Shock absorbers used in conjunction with stop arm mechanisms/air cylinders quickly decelerate large paper rolls moving through production on inclined planes, without damage or jolting. This increases operating speed and decreases machinery damage and paper waste.

**AUTOMOTIVE – TRANSFER LINE**
Automated assembly plants use OEM large shock absorbers extensively to decelerate and protect shuttle/transfer line systems. This is especially beneficial in the robotic welding location.

**AIR CYLINDER**
Special OEM series shock absorber installed on a trunion mounted, thru-rod, pneumatic cylinder, absorbs the energy created from this drive actuator, which controls the seal and cut operation on a vertical form, fill seal and packaging machine.

**ROBOTIC ASSEMBLY EQUIPMENT**
Use of an HP 110 on high speed robotic assembly equipment prevents potential equipment damage from slide mechanism overrun and increases maximum equipment operating speed.

**PACKAGING MACHINERY**
Standard HP models control rapid movement of a table transporting loaded packages to an automated case packer sealing station, for safe and precise machinery operation.
Application Examples

COORDINATE MEASURING MACHINE
PRO Series shock absorbers decelerate horizontal movement of tower to protect delicate electronic device from damage. PRO Model also decelerates total carriage movement during override conditions.

RODLESS CYLINDERS
PRO Series shock absorbers permit higher rod cylinder loads/velocities, as well as increased operational life, by providing smooth, even deceleration.

CIRCUIT BREAKER
On an industrial circuit breaker, an STH is used to extend equipment life by controlling the bounce back of the large springs used to open and close circuit connections.

MACHINE TOOLS
PM shock absorbers installed on a vertical CNC tool changer allow rapid tool changing by controlling rotational motion, vibration and impact noise of the spindle.

WOODWORKING EQUIPMENT
An ADA 500 model ensures consistent cutting speeds through varied material on a cut-off saw.

AUTOMATED STORAGE & RETRIEVAL SYSTEM
HP Models serve as industry-approved safety stops and also cushion a vertical carriage’s deceleration in an automatic storage/retrieval system, for more accurate carriage positioning, decreased product spillage and increased system life.

OVERHEAD CRANES
Shock absorbers softly yet quickly decelerate trolley movement and serve as safety stops when mounted at each end of an overhead crane bridge (can be designed to meet various safety standards).

MACHINE TOOLS
PM shock absorbers installed on a vertical CNC tool changer allow rapid tool changing by controlling rotational motion, vibration and impact noise of the spindle.

TRANSPORT EQUIPMENT
Jarring of passengers and cargo is eliminated when HD shock absorbers are installed at end positions of cable and other transport systems.

STACKER CRANES
Shock absorbers designed to meet custom operational requirements, provide reliable, positive deceleration and prevent potential tipping of a computer-operated stacker crane, under runaway conditions.
Application Examples

**POWER & FREE CONVEYOR**
Special Double Acting DA’s or TowBar (TB) snubbers are used on a conveyor system to eliminate the abrupt start and stop motion imposed on the transported load. This eliminates damage to the load and conveyor.

**MATERIAL HANDLING**
Potential damage to transported parts caused by swinging of overhead conveyor system is eliminated by employing an ADA Series rate control to stabilize swinging load.

**FOOD PROCESSING**
Using an Enidine ADA Series unit on a bread/food slicer controls blade descent rate to extend slicer life expectancy, eliminate bread/food breakage when slicing, increase safety of the slicing operation and reduce frequency of knife sharpening.

**REFRIGERATION CASE**
Installation of an ADA Series rate control on a refrigeration case allows both controlled opening and closing of a refrigeration case lid, resulting in improved energy savings, customer safety, and decreased case damage.

**AIR CYLINDER**
An ADA Series rate control attached to an air cylinder allows it to operate with the smooth, operational consistency of a hydraulic cylinder.

**TURNSTILE**
A PM Series shock absorber on a turnstile eliminates over-rotation and bounce back of turnstile arms, which prolongs the turnstile’s life, while providing for a more comfortable entry and exit.

**OVERHEAD CARRIER**
DA Models mounted on an overhead carrier allow the loaded transport bed to be smoothly and safely unfolded for assembly and refolded for compact travel through the production line.

**FOOD PROCESSING**
Using an Enidine ADA Series unit on a bread/food slicer controls blade descent rate to extend slicer life expectancy, eliminate bread/food breakage when slicing, increase safety of the slicing operation and reduce frequency of knife sharpening.

**MATERIAL HANDLING**
Potential damage to transported parts caused by swinging of overhead conveyor system is eliminated by employing an ADA Series rate control to stabilize swinging load.
Application Worksheet

APPLICATION DATA

Description: ____________________________________________________________

Motion Direction (Check One):

☐ Horizontal ☐ Vertical ☐ Down ☐ Up ☐ Incline ☐ Rotary Horizontal ☐ Rotary Vertical ☐ Down

Weight (Min./Max.): ________________________________ (kg)

Cycle Rate: __________________________________________ (cycles/hour)

Additional Propelling Force (If Known) __________________________ (N)

☐ Air Cyl: Bore ______ (mm) Max. Pressure ______ (bar) Rod Dia. ______ (mm)

☐ Hydraulic Cyl: Bore ______ (mm) Max. Pressure ______ (bar)

☐ Motor _____________ (kW) Torque _____________ (Nm)

Ambient Temp. _____________________________________________ °C

Environmental Considerations: ____________________________________________

SHOCK ABSORBER APPLICATION

No. Shock Absorbers to Stop Load ______________________________________

Impact Velocity (min/max) ___________________________ (m/sec)

Shock Absorber Stroke Requirements: _______________________ (mm)

G Load Requirements ________ (m/sec²)

RATE CONTROL APPLICATION

No. of Rate Controls to Control the Load ______________________________

Control Direction: ☐ Tension (T) ☐ Compression (C)

Required Stroke: _________ (mm) Est. Stroke Time (t) _________ (sec)

Estimated Velocity at the Rate Control (V) _________ (m/sec)

GENERAL INFORMATION

CONTACT: _____________________________________________________________

DEPT/TITLE: ___________________________________________________________

COMPANY: _____________________________________________________________

ADDRESS: _____________________________________________________________

TEL: __________________________________________________________________

FAX: __________________________________________________________________

E-MAIL: __________________________________________________________________

PRODUCTS MANUFACTURED: ____________________________________________

APPLICATION SKETCH/NOTES

The Enidine Application Worksheet makes shock absorber and rate control sizing and selection easier.

Upon Enidine’s receipt of this worksheet, you will receive a detailed analysis of your application and product recommendations. (For custom design projects, Enidine representatives will consult with you for specification requirements.)

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Solutions in Energy Absorption and Vibration Isolation.