ITT

Heavy Duty Shock Absorbers

Engineered for life

HEAVY DUTY SHOCK ABSORBERS

Applications:

- Amusement ride emergency stops
- Transportation safety stops
- Ladle transfer cars
- Coil upenders/downenders
- Rolling mill chock separators
- Furnace slab bumpers
- Hot strip mill down-coiler
- Re-heat furnace entry end shock absorber
- Gantry/Stacker Cranes

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Product Selection

Energy Absorption Products

Enidine, a preferred source for energy absorption and vibration isolation solutions, offers a full range of Heavy Duty (HDN/HDA) products, each designed to protect equipment from large impacts in applications where consistent deceleration and safety is required.

Need Assistance? Enidine is ready to answer your questions, feel free to contact us at:

Phone: +49 6063 9314 0

Fax: +49 6063 9314 44

Email: info@enidine.eu

Online: www.enidine.eu

Overview

With its world headquarters located in Orchard Park, New York, USA, **ENIDINE Incorporated** is a world leader in the design and manufacture of standard and custom energy absorption and vibration isolation product solutions within the Industrial, Aerospace, Defense, Marine and Rail markets. Product ranges include shock absorbers, gas springs, rate controls, air springs, wire rope isolators, heavy industry buffers and emergency stops. With facilities strategically located throughout the world and in partnership with our vast global network of distributors, Enidine Incorporated continues to strengthen its presence within marketplace.

Founded in 1966, Enidine Incorporated now has close to 600 employees located throughout the globe in the United States, Germany, France, Japan, China and Korea. With a team of professionals in engineering, computer science, manufacturing, production and marketing our employees provide our customers the very best in service and application solutions.

"Enidine is widely recognized as the preferred source for energy absorption and vibration isolation products."

From Original Equipment Manufacturers (OEM) to aftermarket applications, Enidine offers a unique combination of product selection, engineering excellence and technical support to meet even the toughest energy absorption application requirements.

Global Manufacturing and Sales Facilities offer our customers:

- ***Highly Trained Distribution Network***
- ***State-of-the Art Engineering Capabilities***
- ***Custom Solution Development***
- ***Customer Service Specialists***
- ***Multiple Open Communication Channels***

If you are unsure whether one of our standard products meets your requirements, feel free to speak with one of our technical representatives **at +49 6063 9314 0**, or contact us via **e-mail at info@enidine.eu**.

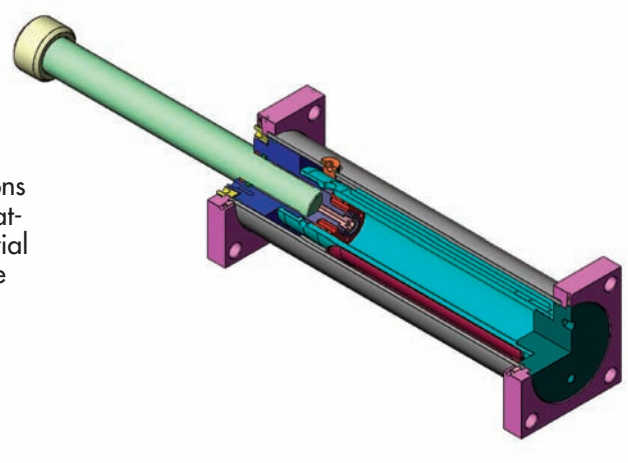
Products/Engineering/Technical Support

Enidine continually strives to provide the widest selection of shock absorbers and rate control products in the global marketplace. Through constant evaluation and testing, we bring our customers the most cost effective products with more features, greater performance and improved ease of use.

New Products and Services

Enidine engineers continue to monitor and influence trends in the motion control industry, allowing us to remain at the forefront of new energy absorption and vibration isolation 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.



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 customized to your exact specifications.

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***
- ***3-D CAD Drawings***
- ***3-D Soluble Support Technology***
- ***Finite Element Analysis***
- ***Complete Product Verification 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.

Global Service and Support

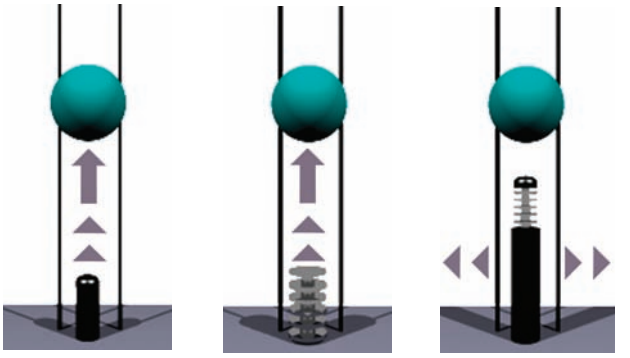
Enidine offers its customers a global network of customer service staff technical sales personnel that are available to assist you with all of your application needs.

- Operating with lean manufacturing and cellular production, Enidine produces higher quality custom and standard products with greater efficiency and within shorter lead times.
- An authorized Global Distribution Network is trained regularly by ENIDINE staff on new products and services ensuring they are better able to serve you.
- Global operations in United States, Germany, China and Japan.
- A comprehensive, website full of application information, technical data, sizing examples and information to assist in selecting the product that's right for you.

Our website also features a searchable worldwide distributor lookup to help facilitate fast, localized service. Contact us today for assistance with all of your application needs.

Our global customer service and technical sales departments are available to assist you find the solution that's right for your application needs. Call us at +49 6063 9314 0 or e-mail us at info@enidine.eu and let us get started today.

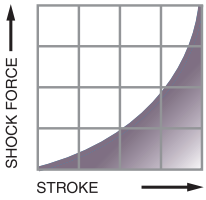
As companies strive to increase productivity by operating machinery at higher speeds, often the results are increased noise, damage to machinery/products, and excessive vibration. At the same time, safety and machine reliability are decreased. A variety of products are commonly used to solve these problems. 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:



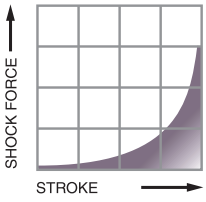
Rubber Bumper | **Metal Spring** | **Enidine Shock Absorber**

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.

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 weight or 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.

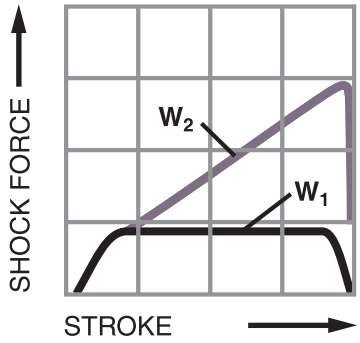


Figure 1

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.

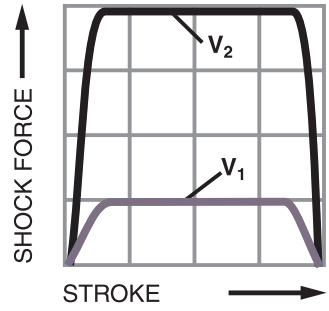
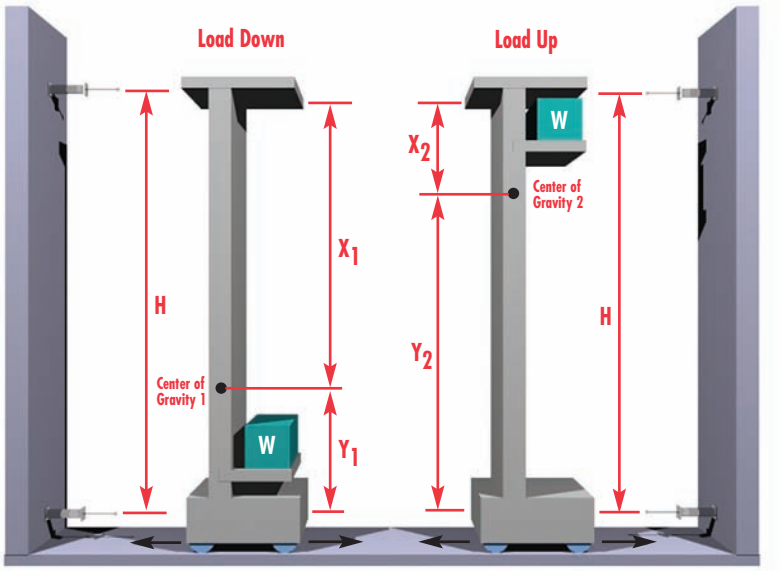


Figure 2

Shock Absorber Sizing Examples
Typical Shock Absorber and Stacker Crane Application

Application 1	Value
Buffer Distance H	m
Distance X_1	m
Distance Y_1	m
Distance X_2	m
Distance Y_2	m
Total Weight	t
$W_{max\ d}$	t
$W_{min\ d}$	t
$W_{max\ u}$	t
$W_{min\ u}$	t



Calculation Example Stacker Cranes

Please note that this example shows how to calculate the maximum impact weight on the upper and lower shock absorbers for a stacker crane.

Distance Between Buffers:	**H = 20 m**	**Given Values**
Distance to C of G1 - Upper:	**X_1 = 15 m**	
Distance to C of G1 - Lower:	**Y_1 = 5 m**	
Distance to C of G2 - Upper:	**X_2 = 7 m**	
Distance to C of G1 - Lower:	**Y_2 = 13 m**	
Total Weight:	**W = 20 t**	
$W_{max\ d} = \frac{X_1}{H} \bullet W$	$W_{max\ d} = \frac{X_2}{H} \bullet W$	**Calculation for Lower Shock Absorbers**
$W_{max\ d} = \frac{15\ m}{20\ m} \bullet 20\ t$	$W_{max\ d} = \frac{7\ m}{20\ m} \bullet 20\ t$	
$W_{max\ d} = 15\ t$	$W_{max\ d} = 7\ t$	
$W_{max\ d} = \frac{Y_1}{H} \bullet W$	$W_{max\ d} = \frac{Y_2}{H} \bullet W$	**Calculation for Upper Shock Absorbers**
$W_{max\ d} = \frac{5\ m}{20\ m} \bullet 20\ t$	$W_{max\ d} = \frac{13\ m}{20\ m} \bullet 20\ t$	
$W_{max\ d} = 5\ t$	$W_{max\ d} = 13\ t$	
Using the value for W_{max} obtained above, the kinetic energy can be calculated, and a shock absorber selected.		**Shock Absorber Selection**

Shock Absorber Sizing Examples
Typical Shock Absorber and Crane Applications

Calculaions assume worst case scenario of 90% trolley weight over one rail.

Crane A		Per Buffer
Propelling Force Crane	kN	
Propelling Force Trolley	kN	
Weight of Crane (W_a)	t	
Weight of Trolley (W_{ta})	t	
Crane Velocity (V_a)	m/s	
Trolley Velocity (V_{ta})	m/s	

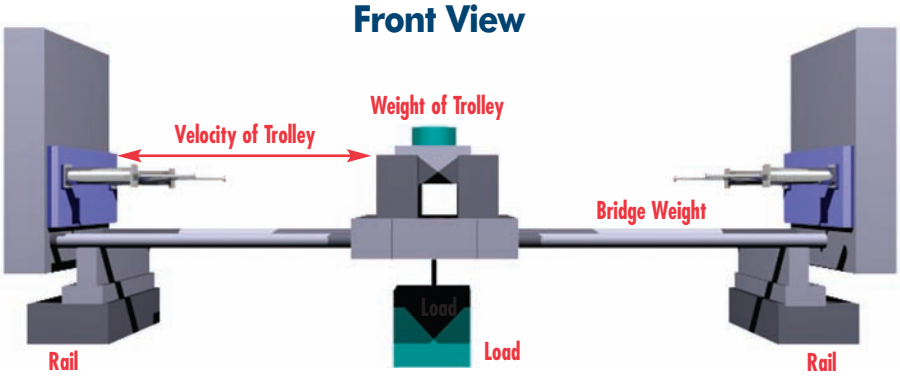
Crane B		Per Buffer
Propelling Force Crane	kN	
Propelling Force Trolley	kN	
Weight of Crane (W_a)	t	
Weight of Trolley (W_{ta})	t	
Crane Velocity (V_a)	m/s	
Trolley Velocity (V_{ta})	m/s	

Crane C		Per Buffer
Propelling Force Crane	kN	
Propelling Force Trolley	kN	
Weight of Crane (W_a)	t	
Weight of Trolley (W_{ta})	t	
Crane Velocity (V_a)	m/s	
Trolley Velocity (V_{ta})	m/s	

Please note:
Unless instructed otherwise, Enidine will always calculate with:

- 100% velocity v, and
- 100% propelling force F_D

Front View



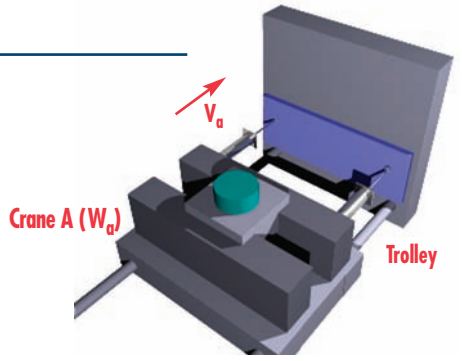
Plan Views

Application 1
Crane A against Solid Stop
Velocity:

$V_r = V_a$

Impact weight per buffer:

$$W_d = \frac{Wa + (1.8)\ Wta}{\text{Total Number of Shocks}}$$



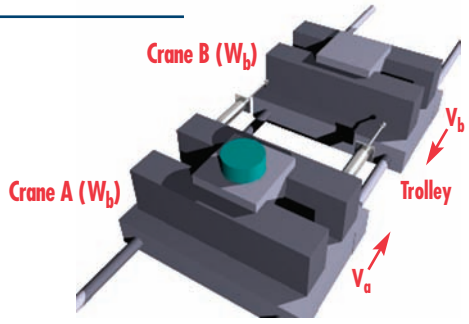
Application 2
Crane A against Crane B
Velocity:

$V_r = V_a + V_b$

Impact weight per buffer:

$W_1 = Wa + (1.8)\ Wta$
$W_2 = Wb + (1.8)\ Wtb$

$$W_d = \frac{W_1\ W_2}{(W_1 + W_2)(\text{Total Number of Shocks})}$$



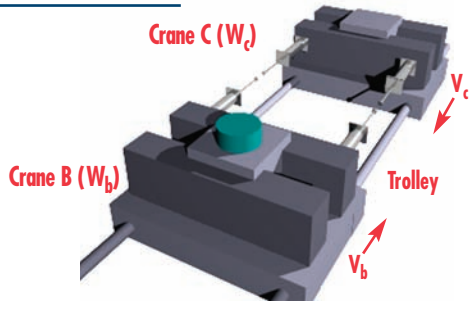
Application 3
Crane B against Crane C
Velocity:

$$V_r = \frac{V_b + V_c}{2}$$

Impact weight per buffer:

$W_1 = Wb + (1.8)\ Wtb$
$W_2 = Wc + (1.8)\ Wtc$

$$W_d = \frac{2\ W_1\ W_2}{(W_1 + W_2)(\text{Number of Shocks Per Rail})}$$



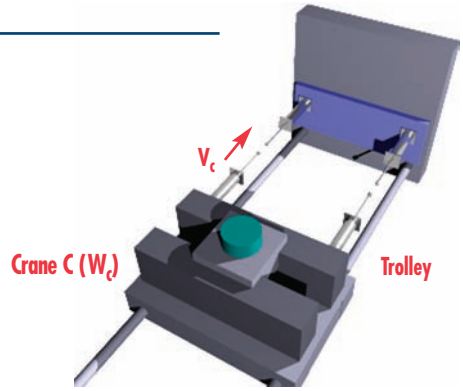
Application 4
Crane C against Solid Stop with Buffer
Velocity:

$$V_r = \frac{V_c}{2}$$

Impact weight per buffer:

$W_1 = W_c + 1.8\ (W_{tc})$

$$W_d = \frac{2\ W_1}{\text{Number of Shocks Per Rail}}$$



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.

Calculation Example for Harbor Cranes as Application 1

Given Values

Total Weight of Bridge:	**380 t**
Weight of Trolley:	**45 t**
Crane Velocity:	**1,5 m/s**
Required Stroke:	**600 mm**
Trolley Velocity:	**4,0 m/s**
Required Stroke:	**1 000 m**

Determination of the Maximum Impact Mass W_d per Buffer

$$W_d = \frac{Wa + 1.8\ W+a}{\text{Total Number of Shocks}}$$

$$W_d = \frac{380\ t + (1.8)45\ t}{2}$$

W_d = 230.5 t

Determine Size of Shock Absorber for Crane

$$E_K = \frac{W_d}{2} \bullet V_r^2$$

$$E_K = \frac{230.5}{2} \bullet (1,5\ m/s)^2$$

E_K = 259 kN

$V_r = V_A$ (Application 1)

E_K = Kinetic Energy

η = Efficiency

Selecting for required 600mm stroke:
HD 5.0 x 24, maximum shock force ca. 460 kN = $F_s = \frac{E_K}{s \bullet \eta}$

Determine Size of Shock Absorber for Trolley

M_D = Trolley Mass per Shock Absorber

$$M_D = \frac{45\ t}{2}$$

M_D = 22,5 t

$$E_K = \frac{M_D}{2} \bullet V_r^2$$

$$E_K = \frac{22,5\ t}{2} \bullet (4\ m/s)^2$$

E_K = 180 kNm

$V_r = V_A$ Application 1

Selecting for required 1 000 mm stroke:
HDN 4.0 x 40, maximum shock force ca. 212 kN = $F_s = \frac{E_K}{s \bullet \eta}$

Heavy Duty Shock Absorbers
HDN, HDA Series

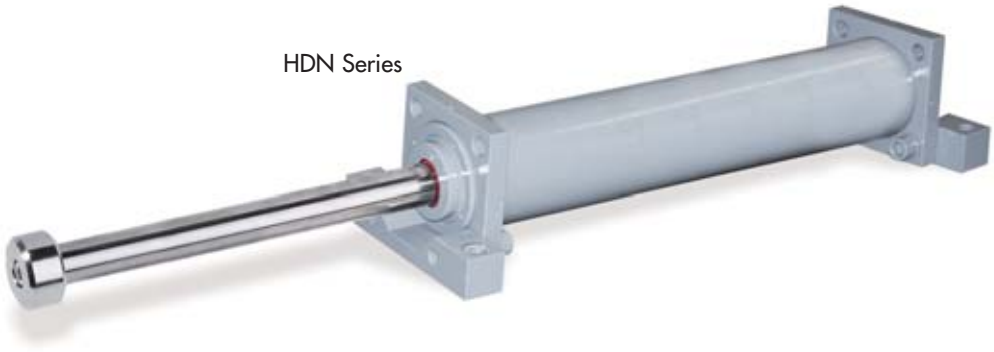
Overview

Enidine Heavy Duty Series 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.

HDN 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 4 in. (100mm) and strokes over 60 in. (1524mm).

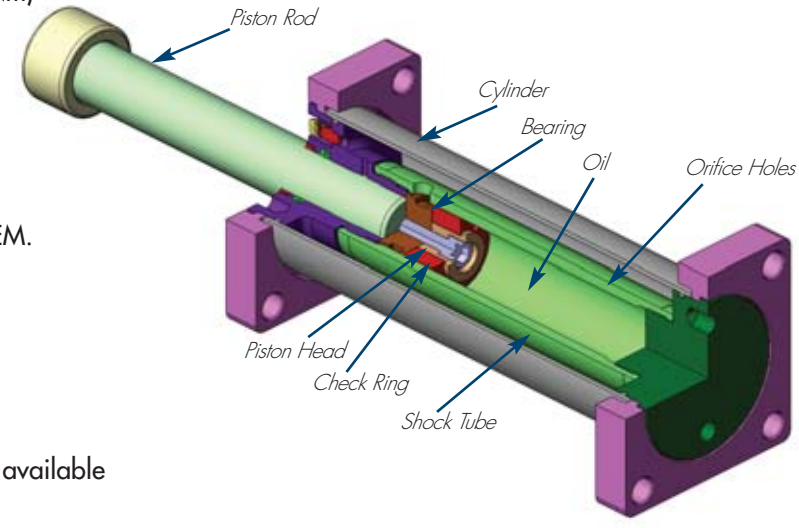
HDA Series
Adjustable units enable the user to modify shock absorber resistance to accommodate load velocity variations, with strokes up to 12in. (305mm). Standard adjustable configurations available.

HDN Series

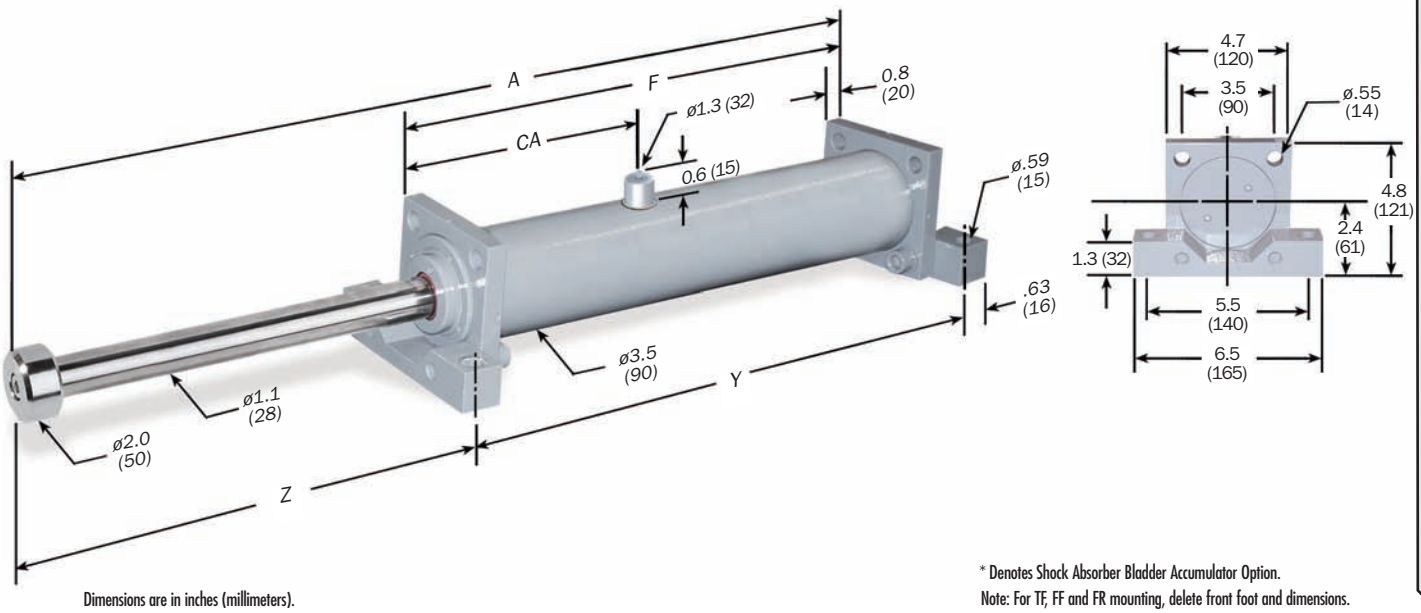


Features and Benefits HDN, HDA

- Designed with Environmentally friendly materials and fluids
- Compact design smoothly and safely decelerates large energy capacity loads up to 3,000,000 in-lbs. per cycle (330 000 Nm)
- Internal charged air/oil accumulator replaces mechanical return springs, providing shorter overall length and reduced weight. **Optional** Bladder Accumulator (BA) for higher cycle rates, also available.
- Engineered to meet OSHA, AISE, CMAA and other safety specifications such as DIN and FEM.
- Wide variety of optional configurations including bellows, clevis mounts and safety cables.
- Painted external components provide excellent corrosion protection.
- Epoxy painting and special rod materials are available for use in highly corrosive environments.
- All sizes are fully field repairable.
- Piston rod extension sensor systems available for re-use safety requirements.
- Incorporating optional fluids and seal packages can expand standard operating temperature range from 15°F to 140°F (-10°C to 60°C) to -30°F to 210°F (-35°C to 100°C)



HDN 1.5 x 2 → HDN 1.5 x 32 Series



Dimensions are in inches (millimeters).

* Denotes Shock Absorber Bladder Accumulator Option.

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

Catalog No./ Model	(S) Stroke in. (mm)	(E_T) Max. in.-lbs./cycle (Nm/cycle)	(E_TC) Max. in.-lbs./hour (Nm/hr)	(F_P) Max. Shock Force lbs. (N)	Nominal Return Force BA* lbs. (N)	Nominal Return Force w/o BA* lbs. (N)	A in. (mm)	F in. (mm)	Y in. (mm)	Z in. (mm)	CA BA* in. (mm)	CA w/o BA* in. (mm)	Model Weight lbs. (Kg)
HDN 1.5 x 2	2 (50)	27,900 (3 200)	1,676,000 (189 000)	15,750 (70 060)	50 (220)	70 (320)	12.2 (310)	8.2 (208)	9.4 (240)	3.4 (86)	5.5 (139)	1.6 (41)	22 (10)
HDN 1.5 x 4	4 (100)	54,200 (6 100)	3,257,300 (368 000)	15,750 (70 060)	50 (220)	90 (410)	16.1 (410)	10.2 (258)	11.4 (290)	5.4 (136)	5.5 (139)	1.6 (41)	24 (12)
HDN 1.5 x 6	6 (150)	80,600 (9 100)	4,838,500 (546 700)	15,750 (70 060)	50 (220)	100 (450)	20.1 (510)	12.1 (308)	13.4 (340)	7.3 (186)	5.5 (139)	1.6 (41)	26 (12)
HDN 1.5 x 8	8 (200)	108,000 (12 200)	6,482,900 (732 500)	15,750 (70 060)	50 (220)	120 (525)	24.1 (613)	14.2 (360)	15.4 (392)	9.3 (237)	5.5 (139)	1.6 (41)	29 (13)
HDN 1.5 x 10	10 (250)	134,900 (15 200)	6,912,000 (781 000)	15,750 (70 060)	50 (220)	135 (600)	28.2 (715)	16.2 (411)	17.4 (443)	11.3 (288)	5.5 (139)	1.6 (41)	31 (14)
HDN 1.5 x 12	12 (300)	161,800 (18 300)	7,769,700 (877,900)	15,750 (70 060)	50 (220)	210 (920)	32.2 (817)	18.2 (462)	19.4 (494)	13.3 (339)	5.5 (139)	1.6 (41)	35 (16)
HDN 1.5 x 14	14 (350)	185,100 (20 900)	8,610,500 (972,900)	15,750 (70 060)	50 (220)	250 (1 120)	36.1 (918)	20.2 (512)	21.4 (544)	15.4 (390)	5.5 (139)	1.6 (41)	37 (17)
HDN 1.5 x 16	16 (400)	208,300 (23 300)	9,468,200 (1 069 800)	13,500 (60 060)	50 (220)	250 (1 120)	40.1 (1 019)	22.2 (563)	23.4 (595)	17.3 (440)	5.5 (139)	1.6 (41)	40 (18)
HDN 1.5 x 18	18 (450)	224,300 (25 300)	10,325,900 (1 166 700)	10,750 (47 820)	50 (220)	250 (1 120)	44.1 (1 121)	24.2 (614)	25.4 (646)	19.3 (491)	5.5 (139)	1.6 (41)	42 (19)
HDN 1.5 x 20	20 (500)	240,300 (27 200)	11,183,600 (1 263 600)	8,750 (38 920)	50 (220)	250 (1 120)	48.2 (1 223)	26.2 (665)	27.4 (697)	21.4 (542)	5.5 (139)	1.6 (41)	44 (20)
HDN 1.5 x 24	24 (600)	269,600 (30 500)	12,899,000 (1 457 400)	6,250 (27 800)	50 (220)	250 (1 120)	56.2 (1 427)	30.2 (767)	31.5 (799)	21.3 (644)	5.5 (139)	1.6 (41)	50 (23)
HDN 1.5 x 28	28 (713)	297,000 (33 600)	14,597,600 (1 649 300)	4,750 (21,130)	50 (220)	250 (1 120)	64.1 (1 629)	34.2 (868)	35.4 (900)	29.3 (745)	5.5 (139)	1.6 (41)	44 (20)
HDN 1.5 x 32	32 (813)	322,800 (36 500)	16,279,300 (1 839 300)	3,700 (16 460)	50 (220)	250 (1 120)	72.0 (1 830)	38.1 (968)	39.4 (1 000)	33.3 (846)	5.5 (139)	1.6 (41)	50 (23)

Notes: 1. HDN 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 12 inch (300 mm) strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.

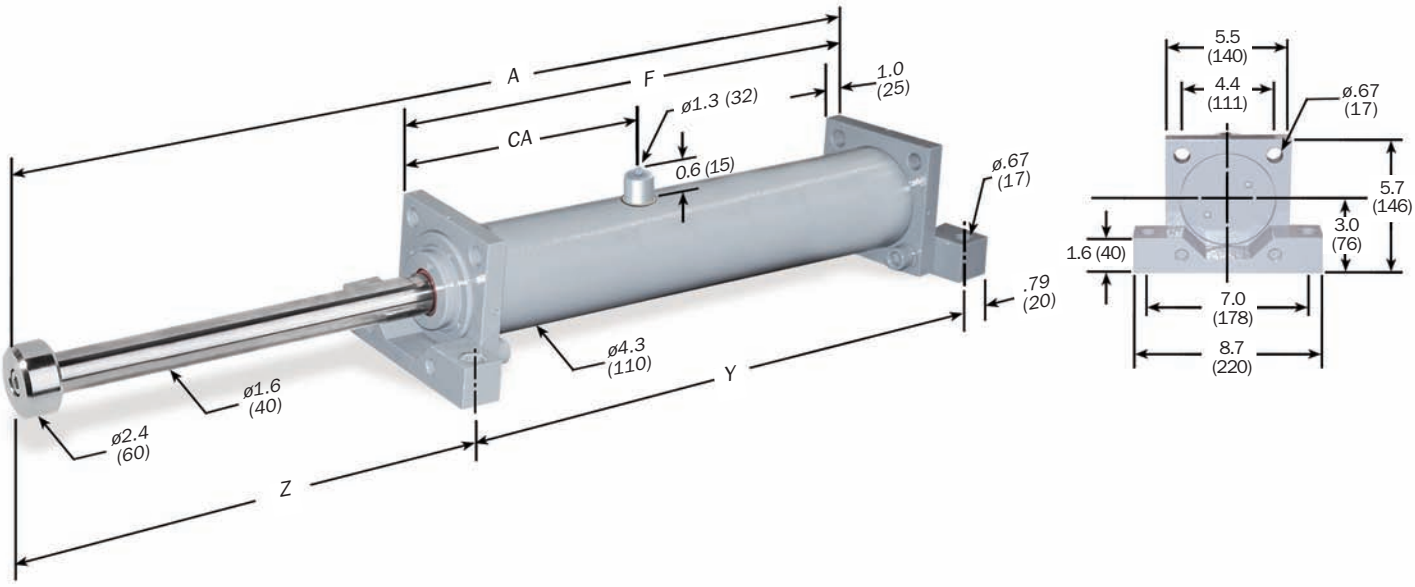
5. Maximum cycle rate is 60 cycles/hr. for HDN with BA option and 30 cycles/hr. without BA option.

6. For impact velocities over 180 in./sec. (4.5 m/s), consult factory.

Heavy Duty Series Shock Absorber
HDN 2.0 Series

Technical Data

HDN 2.0 x 6 → HDN 2.0 x 56 Series



Dimensions are in inches (millimeters).

* Denotes Shock Absorber Bladder Accumulator Option.
Note: For TF, FF and FR mounting, delete front foot and dimensions.

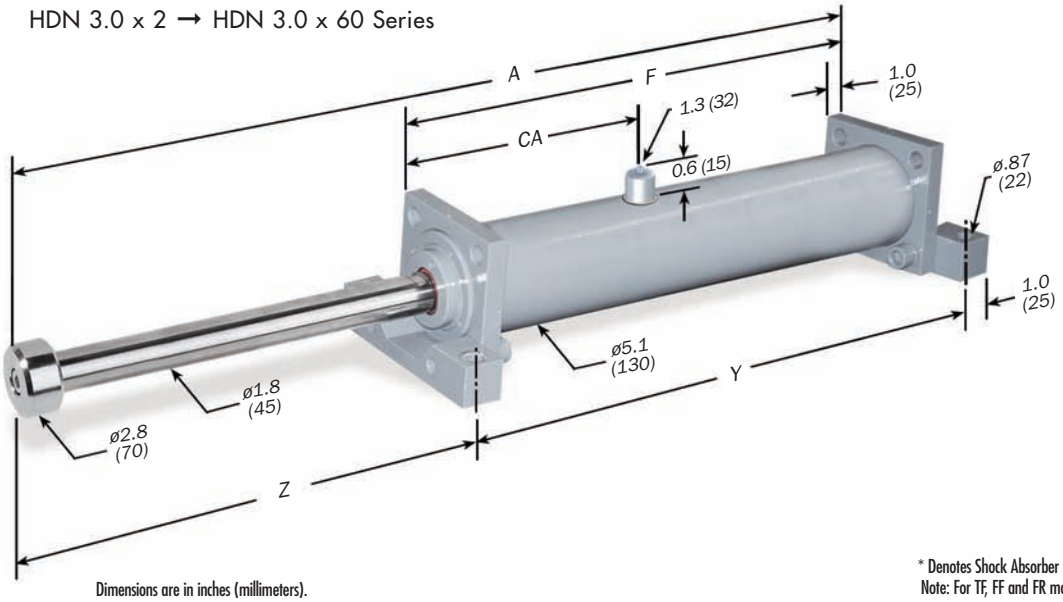
Catalog No./ Model	(S) Stroke in. (mm)	(E_T) Max. in.-lbs./cycle (Nm/cycle)	(E_TC) Max. in.-lbs./hour (Nm/hr)	(F_P) Max. Shock Force lbs. (N)	Nominal Return Force BA* lbs. (N)	Nominal Return Force w/o BA* lbs. (N)	A in. (mm)	F in. (mm)	Y in. (mm)	Z in. (mm)	CA BA* in. (mm)	CA w/o BA* in. (mm)	Model Weight lbs. (Kg)
HDN 2.0 x 6	6 (152)	127,200 (14 400)	7,629,900 (862 100)	25,000 (111 200)	120 (535)	200 (870)	21.8 (553)	13.3 (339)	14.9 (379)	7.6 (194)	6.9 (176)	1.8 (46)	51 (23)
HDN 2.0 x 8	8 (203)	169,800 (19 200)	8,086,900 (913 700)	25,000 (111 200)	120 (535)	235 (1 040)	25.8 (655)	15.4 (390)	16.9 (430)	9.6 (245)	6.9 (176)	1.8 (46)	55 (25)
HDN 2.0 x 10	10 (250)	212,500 (24 000)	9,144,400 (1 033 200)	25,000 (111 200)	120 (535)	300 (1 340)	29.8 (757)	17.4 (441)	18.9 (481)	11.7 (296)	6.9 (176)	1.8 (46)	51 (23)
HDN 2.0 x 12	12 (300)	253,200 (28 600)	10,201,900 (1 152 700)	25,000 (111 200)	120 (535)	515 (2 290)	33.8 (859)	19.4 (492)	20.9 (532)	13.7 (347)	6.9 (176)	1.8 (46)	55 (25)
HDN 2.0 x 14	14 (350)	285,900 (32 300)	11,259,500 (1 272 100)	25,000 (111 200)	120 (535)	515 (2 290)	37.8 (960)	21.4 (543)	23.0 (583)	15.6 (397)	6.9 (176)	1.8 (46)	60 (27)
HDN 2.0 x 16	16 (400)	318,700 (36 000)	12,317,000 (1 391 600)	25,000 (111 200)	120 (535)	515 (2 290)	41.8 (1 062)	23.4 (594)	25.0 (634)	17.6 (448)	6.9 (176)	1.8 (46)	64 (29)
HDN 2.0 x 18	18 (450)	351,500 (39 700)	13,374,500 (1 511 100)	25,000 (111 200)	120 (535)	515 (2 290)	45.8 (1 164)	25.4 (645)	27.0 (685)	19.6 (499)	6.9 (176)	1.8 (46)	68 (31)
HDN 2.0 x 20	20 (500)	383,600 (43 300)	14,411,300 (1 628 300)	25,000 (111 200)	120 (535)	515 (2 290)	49.8 (1 265)	27.4 (695)	28.9 (735)	21.7 (550)	6.9 (176)	1.8 (46)	73 (33)
HDN 2.0 x 24	24 (600)	449,100 (50 700)	16,526,300 (1 867 200)	25,000 (111 200)	120 (535)	515 (2 290)	57.8 (1 469)	31.4 (797)	33.0 (837)	25.7 (652)	6.9 (176)	1.8 (46)	79 (36)
HDN 2.0 x 28	28 (700)	514,678 (58 200)	18,641,400 (2 106 200)	25,000 (111 200)	120 (535)	515 (2 290)	65.8 (1 672)	35.4 (899)	37.0 (939)	29.6 (753)	6.9 (176)	1.8 (46)	93 (42)
HDN 2.0 x 32	32 (800)	625,600 (70 700)	22,373,800 (2 527 900)	25,000 (111 200)	120 (535)	515 (2 290)	76.9 (1 953)	42.5 (1 079)	44.1 (1 119)	33.6 (854)	10.1 (256)	1.8 (46)	108 (49)
HDN 2.0 x 36	36 (900)	689,500 (77 900)	24,447,300 (2 762 200)	22,500 (100 000)	120 (535)	515 (2 290)	84.7 (2 151)	46.4 (1 179)	48.0 (1 219)	37.5 (952)	10.1 (256)	1.8 (46)	117 (53)
HDN 2.0 x 40	40 (1 000)	746,700 (84,400)	26,520,900 (2 996 500)	19,000 (84 500)	120 (535)	515 (2 290)	92.6 (2 351)	50.4 (1 279)	51.9 (1 319)	41.4 (1 052)	10.1 (256)	1.8 (46)	124 (56)
HDN 2.0 x 48	48 (1 200)	844,100 (95 400)	30,668,000 (3 465 000)	13,500 (60 000)	120 (535)	515 (2 290)	108.3 (2 751)	58.2 (1 479)	59.8 (1 519)	49.3 (1 252)	10.1 (256)	1.8 (46)	141 (64)
HDN 2.0 x 56	56 (1 400)	922,300 (104 200)	35,022,500 (3 957 000)	7,900 (35 100)	120 (535)	515 (2 290)	124.8 (3 171)	66.5 (1 689)	68.1 (1 729)	57.6 (1 462)	10.1/38.4** (256)/(975)	1.8 (46)	161 (73)

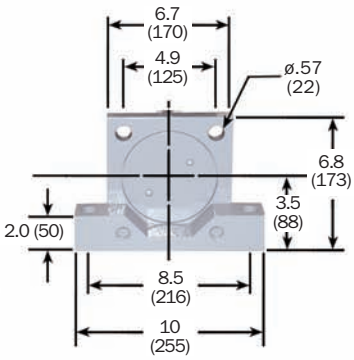
Notes: 1. HDN shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle. If less than these values, a smaller model should be specified.
2. It is recommended that the customer consult Enidine for safety-related overhead crane applications.
3. The energy data listed is for ideal linear impacts only. If side load conditions exist in the application, contact Enidine for sizing assistance.
4. Rear flange mounting of 12 inch (300 mm) strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr. for HDN with BA option and 30 cycles/hr. without BA option.
6. For impact velocities over 180 in./sec. (4.5 m/s), consult factory.
7. ** HDN 2.0 x 56 has two charge ports.

Heavy Duty Series Shock Absorber
HDN 3.0 Series

Technical Data

HDN 3.0 x 2 → HDN 3.0 x 60 Series





Dimensions are in inches (millimeters).

* Denotes Shock Absorber Bladder Accumulator Option.
Note: For TF, FF and FR mounting, delete front foot and dimensions.

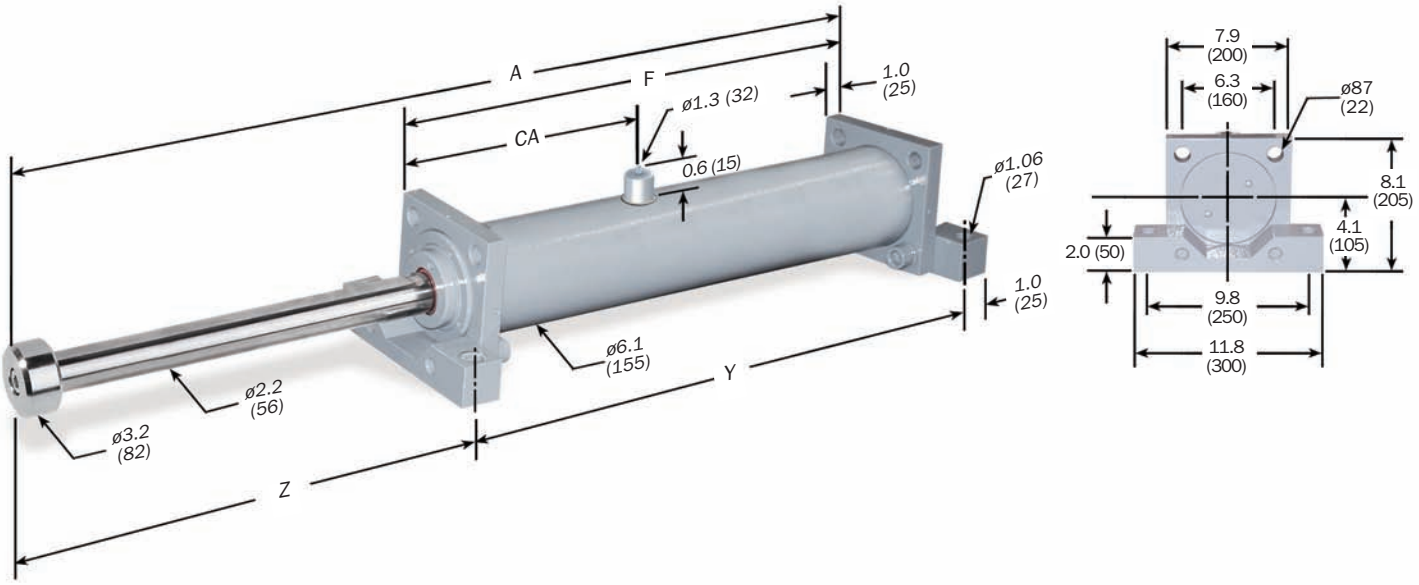
Catalog No./ Model	(S) Stroke in. (mm)	(E_T) Max. in.-lbs./cycle (Nm/cycle)	(E_TC) Max. in.-lbs./hour (Nm/hr)	(F_P) Max. Inital Shock Force lbs. (N)	Nominal Return Force BA* lbs. (N)	Nominal Return Force w/o BA* lbs. (N)	A in. (mm)	F in. (mm)	Y in. (mm)	Z in. (mm)	CA BA* in. (mm)	CA w/o BA* in. (mm)	Model Weight lbs. (Kg)
HDN 3.0 x 2	2 (50)	85,300 (9 600)	5,120,100 (578 500)	50,000 (222 400)	150 (670)	255 (1 130)	13.2 (336)	8.0 (203)	10.0 (253)	4.3 (108)	5.0 (128)	1.8 (46)	40 (21)
HDN 3.0 x 3	3 (75)	128,800 (14 600)	5,832,300 (659 000)	50,000 (222 400)	160 (710)	405 (1 810)	15.2 (387)	9.0 (229)	11.0 (279)	5.2 (133)	5.0 (128)	1.8 (46)	42 (22)
HDN 3.0 x 5	5 (125)	214,200 (24 200)	7,131,200 (805 700)	50,000 (222 400)	165 (735)	650 (2 895)	19.3 (489)	11.0 (280)	13.0 (330)	7.2 (184)	5.0 (128)	1.8 (46)	48 (25)
HDN 3.0 x 8	8 (200)	316,100 (35 700)	9,041,400 (1 021 500)	50,000 (222 400)	170 (755)	650 (2 895)	25.2 (640)	14.0 (355)	15.9 (405)	10.2 (260)	5.0 (128)	1.8 (46)	57 (29)
HDN 3.0 x 10	10 (250)	382,600 (43 200)	10,340,300 (1 168 300)	50,000 (222 400)	175 (780)	650 (2 895)	29.2 (742)	16.0 (406)	18.0 (456)	12.2 (311)	5.0 (128)	1.8 (46)	64 (32)
HDN 3.0 x 12	12 (300)	449,100 (50 700)	11,639,200 (1 315 000)	50,000 (222 400)	175 (780)	650 (2 895)	33.2 (844)	18.0 (457)	20.0 (507)	14.3 (362)	5.0 (128)	1.8 (46)	71 (35)
HDN 3.0 x 14	14 (350)	556,500 (62 900)	14,211,500 (1 605 700)	50,000 (222 400)	180 (800)	650 (2 895)	39.2 (995)	22.0 (558)	23.9 (608)	16.2 (412)	7.0 (178)	1.8 (46)	88 (43)
HDN 3.0 x 16	16 (400)	623,000 (70 400)	15,510,400 (1 752 400)	50,000 (222 400)	180 (800)	650 (2 895)	43.2 (1 097)	24.0 (609)	25.9 (659)	18.2 (463)	7.0 (178)	1.8 (46)	93 (45)
HDN 3.0 x 18	18 (450)	689,400 (77 900)	16,809,300 (1 899 200)	50,000 (222 400)	180 (800)	650 (2 895)	47.2 (1 199)	26.0 (660)	28.0 (710)	20.2 (514)	7.0 (178)	1.8 (46)	99 (48)
HDN 3.0 x 20	20 (500)	755,900 (85 400)	18,108,200 (2 046 000)	50,000 (222 400)	180 (800)	650 (2 895)	51.2 (1 301)	28.0 (711)	30.0 (761)	22.2 (565)	7.0 (178)	1.8 (46)	106 (51)
HDN 3.0 x 24	24 (600)	887,600 (100 300)	20,680,500 (2 336 600)	50,000 (222 400)	180 (800)	650 (2 895)	59.2 (1 504)	32.0 (812)	33.9 (862)	26.3 (667)	7.0 (178)	1.8 (46)	119 (57)
HDN 3.0 x 28	28 (700)	1,020,600 (115 300)	23,278,300 (2 630 100)	50,000 (222 400)	180 (800)	650 (2 895)	67.2 (1 707)	36.0 (914)	38.0 (964)	30.2 (768)	7.0 (178)	1.8 (46)	130 (62)
HDN 3.0 x 32	32 (800)	1,152,200 (130 200)	25,850,700 (2 920 700)	40,500 (180 200)	180 (800)	650 (2 895)	75.2 (1 910)	40.0 (1 015)	41.9 (1 065)	34.3 (870)	7.0 (178)	1.8 (46)	143 (68)
HDN 3.0 x 36	36 (900)	1,307,100 (147 700)	29,645,500 (3 349 500)	36,000 (160 100)	180 (800)	650 (2 895)	84.9 (2 156)	45.8 (1 164)	47.8 (1 214)	38.1 (967)	9.0 (228)	1.8 (46)	163 (77)
HDN 3.0 x 40	40 (1 000)	1,412,700 (159 600)	32,192,300 (3 637 200)	31,500 (140 000)	180 (800)	650 (2 895)	92.8 (2 356)	49.8 (1 264)	51.7 (1 314)	42.0 (1 067)	9.0 (228)	1.8 (46)	176 (85)
HDN 3.0 x 48	48 (1 200)	1,590,700 (179 700)	37,286,100 (4 212 800)	21,500 (95 600)	185 (825)	650 (2 895)	108.5 (2 756)	57.6 (1 464)	59.6 (1 514)	49.9 (1 267)	9.0 (228)	1.8 (46)	200 (94)
HDN 3.0 x 56	56 (1 400)	1,741,300 (196 700)	42,379,800 (4 788 300)	12,500 (55 600)	185 (825)	650 (2 895)	124.3 (3 156)	65.5 (1 664)	67.5 (1 714)	57.8 (1 467)	9.0/37.3** (234)/(947)	1.8 (46)	235 (106)
HDN 3.0 x 60	60 (1 500)	1,830,400 (206 800)	45,283,200 (5 116 300)	11,950 (53 200)	185 (825)	650 (2 895)	133.2 (3 384)	70.0 (1 778)	72.0 (1 828)	62.2 (1 581)	9.0/39.5** (228)/(1004)	1.8 (46)	235 (106)

Notes: 1. HDN 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 12 inch (300 mm) strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr. for HDN with BA option and 30 cycles/hr. without BA option.
6. For impact velocities over 180 in./sec. (4.5 m/s), consult factory.
7. ** HDN 3.0 x 56 and HDN 3.0 x 60 have 2 charge ports.

Heavy Duty Series Shock Absorber
HDN 3.5 Series

HDN 3.5 x 2 → HDN 3.5 x 56 Series

Technical Data



Dimensions are in inches (millimeters).

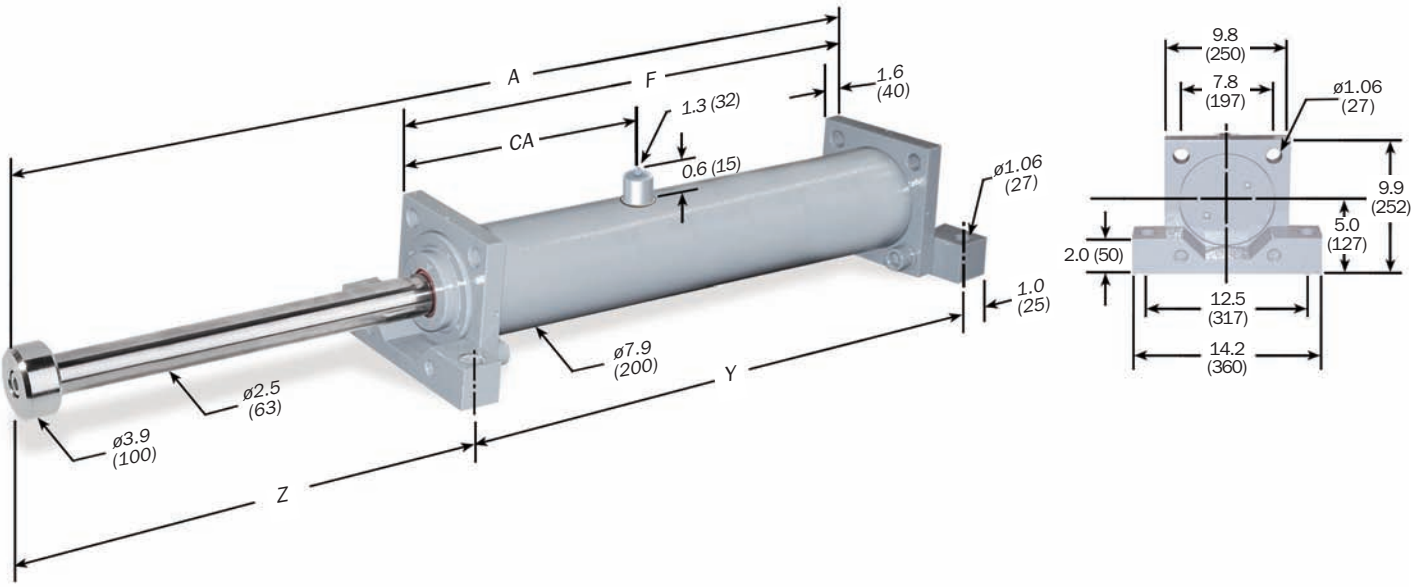
* Denotes Shock Absorber Bladder Accumulator Option.
Note: For TF, FF and FR mounting, delete front foot and dimensions.

Catalog No./ Model	(S) Stroke in. (mm)	(E_T) Max. in.-lbs./cycle (Nm/cycle)	(E_TC) Max. in.-lbs./hour (Nm/hr)	(F_P) Max. Shock Force lbs. (N)	Nominal Return Force BA* lbs. (N)	Nominal Return Force w/o BA* lbs. (N)	A in. (mm)	F in. (mm)	Y in. (mm)	Z in. (mm)	CA BA* in. (mm)	CA w/o BA* in. (mm)	Model Weight lbs. (Kg)
HDN 3.5 x 2	2 (50)	115,200 (13 000)	6,912,100 (781 000)	67,500 (300 250)	215 (960)	455 (2 020)	13.9 (354)	9.6 (244)	11.6 (294)	3.3 (85)	5.3 (134)	2.1 (52)	73 (33)
HDN 3.5 x 4	4 (100)	230,400 (26 000)	8,793,200 (993 500)	67,500 (300 250)	230 (1 020)	610 (2 710)	18.0 (456)	11.6 (295)	13.6 (345)	5.4 (136)	5.3 (134)	2.1 (52)	82 (37)
HDN 3.5 x 6	6 (150)	343,300 (38 800)	10,283,600 (1 161 900)	67,500 (300 250)	260 (1 160)	1,010 (4 480)	21.9 (556)	13.6 (345)	15.6 (395)	7.3 (186)	5.3 (134)	2.1 (52)	90 (41)
HDN 3.5 x 8	8 (200)	450,300 (50 900)	11,803,800 (1 333 600)	67,500 (300 250)	265 (1 180)	1,010 (4 480)	25.9 (658)	15.6 (396)	17.6 (446)	9.3 (237)	5.3 (134)	2.1 (52)	99 (45)
HDN 3.5 x 10	10 (250)	538,400 (60 800)	13,324,000 (1 505 400)	67,500 (300 250)	270 (1 200)	1,010 (4 480)	29.9 (760)	17.6 (447)	19.6 (497)	11.3 (288)	5.3 (134)	2.1 (52)	108 (49)
HDN 3.5 x 12	12 (300)	626,500 (70 800)	14,844,100 (1 677 200)	67,500 (300 250)	270 (1 200)	1,010 (4 480)	33.9 (862)	19.6 (498)	21.6 (548)	13.3 (339)	5.3 (134)	2.1 (52)	117 (53)
HDN 3.5 x 16	16 (400)	801,000 (90 500)	17,854,700 (2 017 300)	67,500 (300 250)	275 (1 225)	1,010 (4 480)	41.9 (1 064)	23.6 (599)	25.6 (649)	17.3 (440)	5.3 (134)	2.1 (52)	132 (60)
HDN 3.5 x 20	20 (500)	1,051,800 (118 800)	22,534,500 (2 546 100)	67,500 (300 250)	275 (1 225)	1,010 (4 480)	52.0 (1 323)	29.8 (756)	31.8 (806)	21.2 (542)	7.4 (189)	2.1 (52)	163 (74)
HDN 3.5 x 24	24 (600)	1,228,000 (138 700)	25,574,800 (2 889 600)	67,500 (300 250)	280 (1 250)	1,010 (4 480)	60.1 (1 527)	33.8 (858)	35.8 (908)	25.3 (644)	7.4 (189)	2.1 (52)	179 (81)
HDN 3.5 x 28	28 (700)	1,402,500 (158 500)	28,585,400 (3 229 700)	67,500 (300 250)	280 (1 250)	1,010 (4 480)	68.0 (1 729)	37.8 (959)	39.8 (1 009)	29.2 (745)	7.4 (189)	2.1 (52)	196 (89)
HDN 3.5 x 32	32 (800)	1,578,700 (178 400)	31,625,800 (3 573 200)	67,500 (300 250)	280 (1 250)	1,010 (4 480)	76.1 (1 933)	41.8 (1 061)	43.8 (1 111)	33.2 (847)	7.4 (189)	2.1 (52)	214 (97)
HDN 3.5 x 36	36 (900)	1,754,900 (198 300)	34,666,100 (3 916 800)	58,500 (260 200)	280 (1 250)	1,010 (4 480)	84.1 (2 137)	45.8 (1 163)	47.8 (1 213)	37.3 (949)	7.4 (189)	2.1 (52)	231 (105)
HDN 3.5 x 40	40 (1 000)	1,918,600 (216 800)	37,676,700 (4 256 900)	48,500 (215 700)	280 (1 250)	1,010 (4 480)	92.1 (2 339)	49.8 (1 264)	51.8 (1 314)	41.3 (1 050)	7.4 (189)	2.1 (52)	247 (112)
HDN 3.5 x 48	48 (1 200)	2,188,000 (247 200)	43,638,200 (4 930 500)	35,000 (155 700)	280 (1 250)	1,010 (4 480)	107.8 (2 739)	57.6 (1 464)	59.6 (1 514)	49.2 (1 250)	7.4 (189)	2.1 (52)	282 (128)
HDN 3.5 x 56	56 (1 400)	2,418,600 (273 300)	49,599,700 (5 604 000)	25,300 (112 500)	470 (2 100)	1,010 (4 480)	107.8 (2 739)	57.6 (1 464)	59.6 (1 514)	49.2 (1 250)	7.4/35.7** (189)/(908)	2.1 (52)	282 (128)

Notes: 1. HDN 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 12 inch (300 mm) strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr. for HDN with BA option and 30 cycles/hr. without BA option.
6. For impact velocities over 180 in./sec. (4.5 m/s), consult factory.
7. ** HDN 3.5 x 56 has two charge ports.

Technical Data

HDN 4.0 x 2 → HDN 4.0 x 48 Series



Dimensions are in inches (millimeters).

* Denotes Shock Absorber Bladder Accumulator Option.
Note: For TF, FF and FR mounting, delete front foot and dimensions.

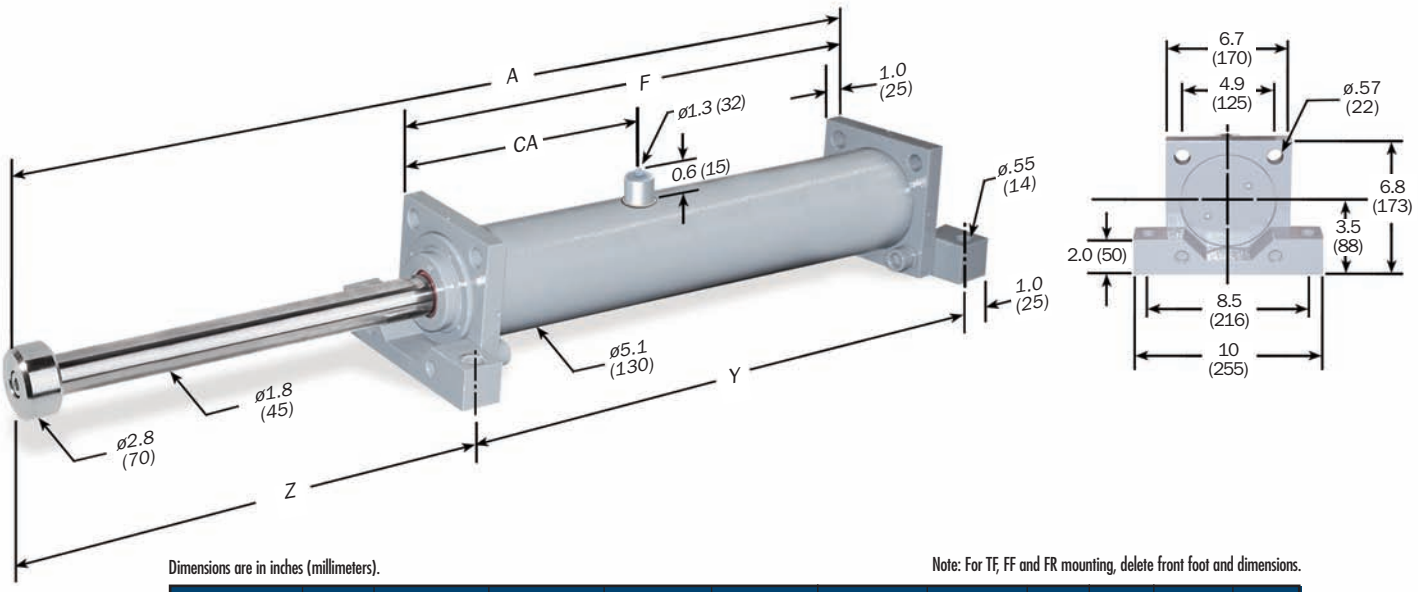
Catalog No./ Model	(S) Stroke in. (mm)	(E_T) Max. in.-lbs./cycle (Nm/cycle)	(E_TC) Max. in.-lbs./hour (Nm/hr)	(F_P) Max. Inital Shock Force lbs. (N)	Nominal Return Force BA* lbs. (N)	Nominal Return Force w/o BA* lbs. (N)	A in. (mm)	F in. (mm)	Y in. (mm)	Z in. (mm)	CA BA* in. (mm)	CA w/o BA* in. (mm)	Model Weight lbs. (Kg)
HDN 4.0 x 2	2 (50)	139,200 (15 700)	8,352,800 (943 700)	80,000 (355 900)	250 (1 100)	425 (1 900)	16.9 (430)	11.6 (294)	13.5 (344)	4.4 (111)	8.1 (206)	2.5 (64)	141 (64)
HDN 4.0 x 4	4 (100)	275,700 (31 200)	13,579,600 (1 534 300)	80,000 (355 900)	270 (1 200)	485 (2 160)	20.9 (532)	13.6 (345)	15.6 (395)	6.4 (162)	8.1 (206)	2.5 (64)	154 (70)
HDN 4.0 x 6	6 (150)	409,606 (46 279)	15,547,700 (1 756 700)	80,000 (355 900)	270 (1 200)	690 (3 050)	24.9 (632)	15.6 (395)	17.5 (445)	8.3 (212)	8.1 (206)	2.5 (64)	168 (76)
HDN 4.0 x 8	8 (200)	548,800 (62 000)	17,594,400 (1 987 900)	80,000 (355 900)	270 (1 200)	980 (4 370)	28.9 (735)	17.6 (447)	19.6 (497)	10.4 (263)	8.1 (206)	2.5 (64)	181 (82)
HDN 4.0 x 10	10 (250)	682,700 (77,100)	19,562,500 (2 210 300)	80,000 (355 900)	270 (1 200)	1,230 (5 465)	32.9 (836)	19.6 (497)	21.5 (547)	12.4 (314)	8.1 (206)	2.5 (64)	192 (87)
HDN 4.0 x 12	12 (300)	819,200 (92 600)	25,269,900 (1 855 100)	80,000 (355 900)	275 (1 225)	1,000 (4 440)	40.6 (1 032)	25.3 (642)	27.2 (692)	14.4 (365)	11.8 (300)	2.5 (64)	238 (108)
HDN 4.0 x 16	16 (400)	1,089,600 (123,100)	29,245,400 (3 304 300)	80,000 (355 900)	275 (1 225)	1,270 (5 650)	48.6 (1 234)	29.3 (743)	31.2 (793)	18.3 (466)	11.8 (300)	2.5 (64)	265 (120)
HDN 4.0 x 20	20 (500)	1,362,700 (154 000)	33,260,200 (3 757 900)	80,000 (355 900)	280 (1 245)	1,155 (5 145)	56.6 (1 438)	33.3 (845)	35.2 (895)	22.4 (568)	11.8 (300)	2.5 (64)	290 (131)
HDN 4.0 x 24	24 (600)	1,635,700 (184 800)	37,275,000 (4 211 500)	80,000 (355 900)	280 (1 245)	1,275 (5 675)	64.6 (1 642)	37.3 (947)	39.3 (997)	26.4 (670)	11.8 (300)	2.5 (64)	317 (144)
HDN 4.0 x 28	28 (700)	1,904,200 (215 100)	41,250,500 (4 660 700)	80,000 (355 900)	280 (1 245)	1,275 (5 675)	72.6 (1 844)	41.3 (1 048)	43.2 (1 098)	30.4 (771)	11.8 (300)	2.5 (64)	346 (157)
HDN 4.0 x 32	32 (800)	2,128,700 (240 500)	45,265,400 (5 114 300)	80,000 (355 900)	280 (1 245)	1,275 (5 675)	80.6 (2 048)	45.3 (1 150)	47.2 (1 200)	34.4 (873)	11.8 (300)	2.5 (64)	375 (170)
HDN 4.0 x 36	36 (900)	2,353,200 (265 900)	49,280,200 (5 567 900)	80,000 (355 900)	280 (1 245)	1,275 (5 675)	88.7 (2 252)	49.3 (1 252)	51.3 (1 302)	38.4 (975)	11.8 (300)	2.5 (64)	403 (183)
HDN 4.0 x 40	40 (1 000)	2,566,000 (289 900)	53,255,700 (6 017 100)	80,000 (355 900)	280 (1 245)	1,275 (5 675)	96.6 (2 454)	53.3 (1 353)	55.2 (1 403)	42.4 (1 076)	11.8 (300)	2.5 (64)	430 (195)
HDN 4.0 x 48	48 (1 200)	2,914,200 (329 300)	61,246,000 (6 919 900)	45,000 (200 000)	280 (1 245)	1,275 (5 675)	112.4 (2 854)	61.3 (1 556)	63.2 (1 606)	50.1 (1 273)	11.8 (300)	2.5 (64)	485 (220)

Notes: 1. HDN 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 12 inch (300 mm) strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr. for HDN with BA option and 30 cycles/hr. without BA option.
6. For impact velocities over 180 in./sec. (4.5 m/s), consult factory.

Heavy Duty Adjustable Series Shock Absorber
HDA 3.0 Series

Technical Data

HDA 3.0 x 2 → HDA 3.0 x 12 Series



Dimensions are in inches (millimeters).

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

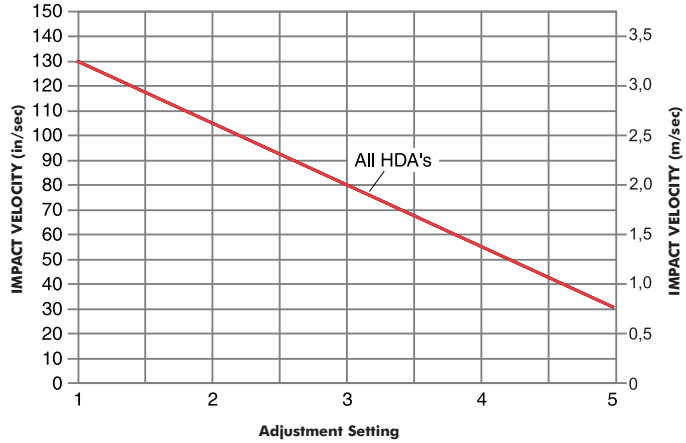
Catalog No./ Model	(S) Stroke in. (mm)	(E_T) Max. in.-lbs./cycle (Nm/cycle)	(E_TC) Max. in.-lbs./hour (Nm/hr)	(F_P) Max. End Shock Force lbs. (N)	Nominal Return Force BA* lbs. (N)	A in. (mm)	F in. (mm)	Y in. (mm)	Z in. (mm)	CA* in. (mm)	Model Weight lbs. (Kg)
HDA 3.0 x 2	2 (50)	40,000 (4 500)	2,400,000 (271 200)	50,000 (222 400)	150 (660)	13.2 (336)	8.4 (213)	10.4 (263)	3.9 (98)	4.4 (112)	40 (21)
HDA 3.0 x 3	3 (75)	60,000 (6 800)	3,600,000 (406 700)	50,000 (222 400)	160 (710)	15.2 (387)	9.4 (239)	11.4 (289)	4.8 (123)	4.4 (112)	42 (22)
HDA 3.0 x 5	5 (125)	100,000 (11 300)	6,000,000 (677 900)	50,000 (222 400)	165 (730)	19.3 (489)	11.4 (290)	13.4 (340)	6.9 (174)	4.4 (112)	48 (25)
HDA 3.0 x 8	8 (200)	160,000 (18 100)	9,296,000 (1 050 300)	50,000 (222 400)	170 (765)	25.2 (640)	14.4 (365)	16.3 (415)	9.8 (250)	4.4 (112)	57 (29)
HDA 3.0 x 10	10 (250)	200,000 (22 600)	10,594,500 (1 197 100)	50,000 (222 400)	175 (775)	29.2 (742)	16.4 (416)	18.3 (466)	11.9 (301)	4.4 (112)	64 (32)
HDA 3.0 x 12	12 (300)	240,000 (27 200)	11,893,800 (1 343 800)	50,000 (222 400)	175 (775)	33.2 (844)	18.4 (467)	20.4 (517)	13.8 (352)	4.4 (112)	71 (35)

Notes: 1. HDA 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 12 inch (300 mm) strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr.
6. HDA models which have an impact velocity below 30 in./sec. (.8 m/sec.), please contact Enidine for assistance.
7. Maximum allowable applied propelling force: 25,000 lbs. (111 200 N)

Adjustment Techniques

HDA

Useable Adjustment Setting Range



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

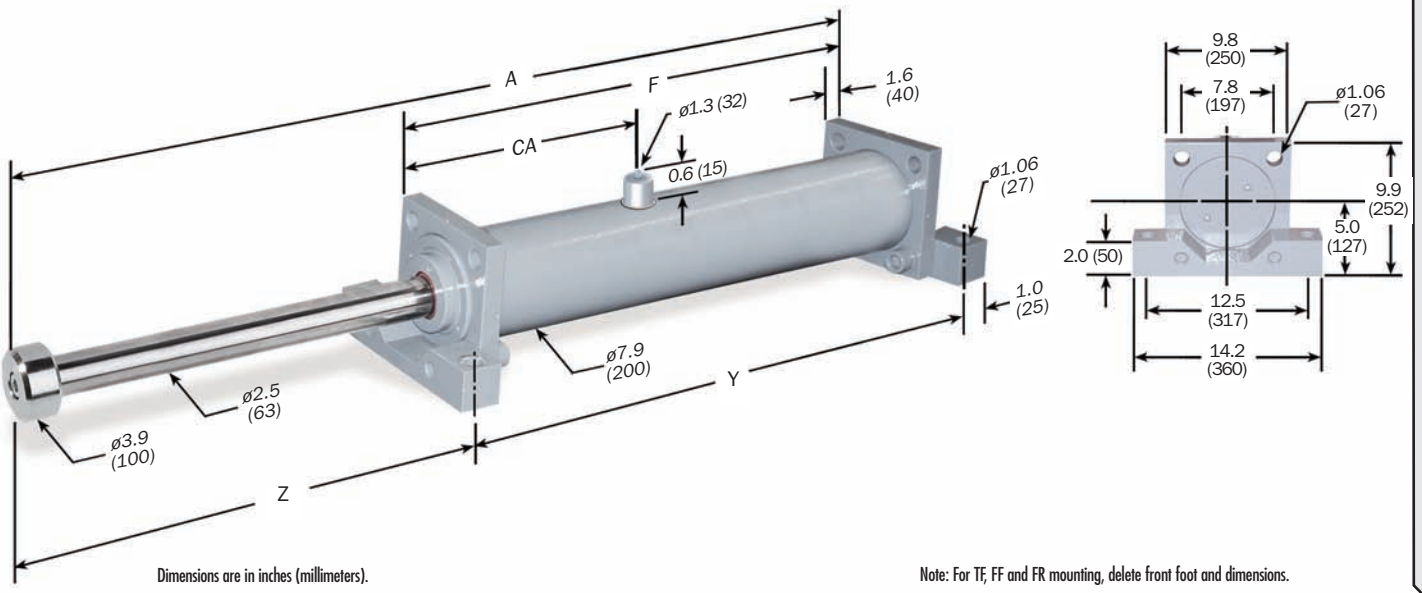
1. Locate the intersection point of the application's impact velocity and the HDA model graph line.
2. The intersection is the maximum adjustment setting to be used. Adjustments exceeding this setting could overload the shock absorber.
3. The useable adjustment setting range is from setting 1 to the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

EXAMPLE: HDA Series

1. Impact Velocity:	80 in./sec. (2 m/s)
2. Intersection Point:	Adjustment Setting 3
3. Useable Adjustment Setting Range:	1 to 3

Technical Data

HDA 4.0 x 2 → HDA 4.0 x 10 Series



Dimensions are in inches (millimeters).

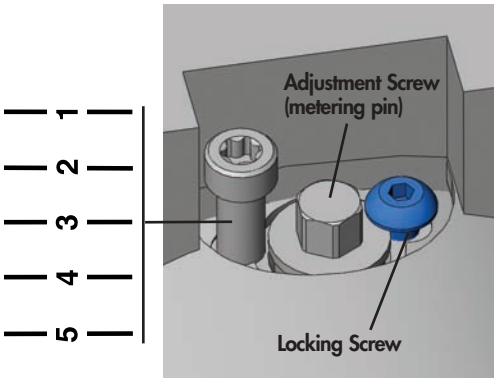
Note: For TF, FF and FR mounting, delete front foot and dimensions.

Catalog No./ Model	(S) Stroke in. (mm)	(E_T) Max. in.-lbs./cycle (Nm/cycle)	(E_TC) Max. in.-lbs./hour (Nm/hr)	(F_P) Max. Shock Force lbs. (N)	Nominal Return Force BA* lbs. (N)	A in. (mm)	F in. (mm)	Y in. (mm)	Z in. (mm)	CA* in. (mm)	Model Weight lbs. (Kg)
HDA 4.0 x 2	2 (50)	120,000 (13 600)	7,200,000 (813 500)	80,000 (355 900)	250 (1 125)	16.9 (430)	12.0 (304)	13.9 (354)	4.0 (101)	7.1 (180)	141 (64)
HDA 4.0 x 4	4 (100)	240,000 (27 100)	13,973,200 (1 578 800)	80,000 (355 900)	250 (1 125)	20.9 (532)	14.0 (355)	15.9 (405)	6.0 (152)	7.1 (180)	154 (70)
HDA 4.0 x 6	6 (150)	360,000 (40 700)	15,941,300 (1 801 100)	80,000 (355 900)	250 (1 125)	24.9 (632)	15.9 (405)	17.9 (455)	8.0 (202)	7.1 (180)	168 (76)
HDA 4.0 x 8	8 (200)	480,000 (54 200)	17,988,100 (2 032 400)	80,000 (355 900)	250 (1 125)	28.9 (735)	18.0 (457)	20.0 (507)	10.0 (253)	7.1 (180)	181 (82)
HDA 4.0 x 10	10 (250)	600,000 (67 800)	19,956,100 (2 254 700)	80,000 (355 900)	250 (1 125)	32.9 (836)	20.0 (507)	21.9 (557)	12.0 (304)	7.1 (180)	192 (87)

Notes: 1. HDA 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 12 inch (300 mm) strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr.
6. HDA models which have an impact velocity below 30 in./sec. (.8 m/sec.), please contact Enidine for assistance.
7. Maximum allowable applied propelling force: 40,000 (177 900 N)

Damping Force

Position 1 provides minimum damping force.
Position 5 provides maximum damping force.

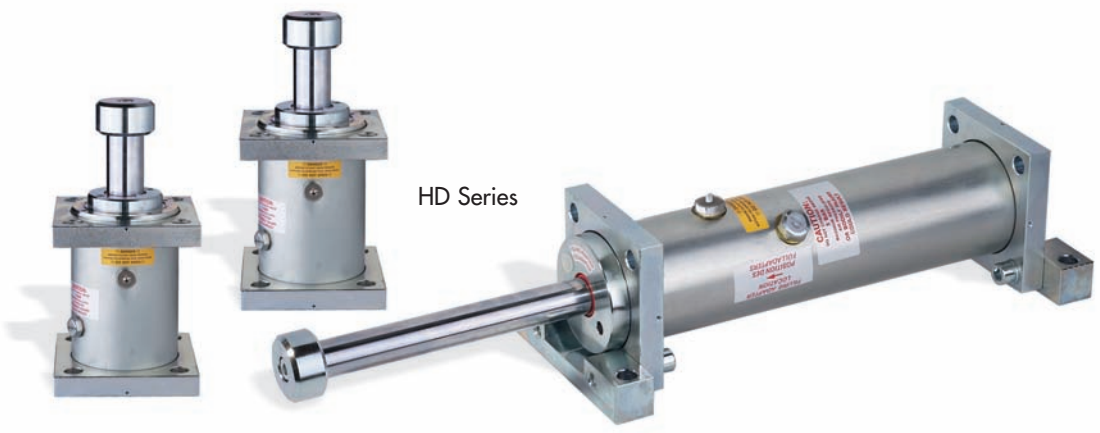


Adjusment Technique

1. Loosen socket head cap screw.
2. Set adjustment screw desired location.
3. Tighten socket head cap screw on shoulder of adjustment screw.

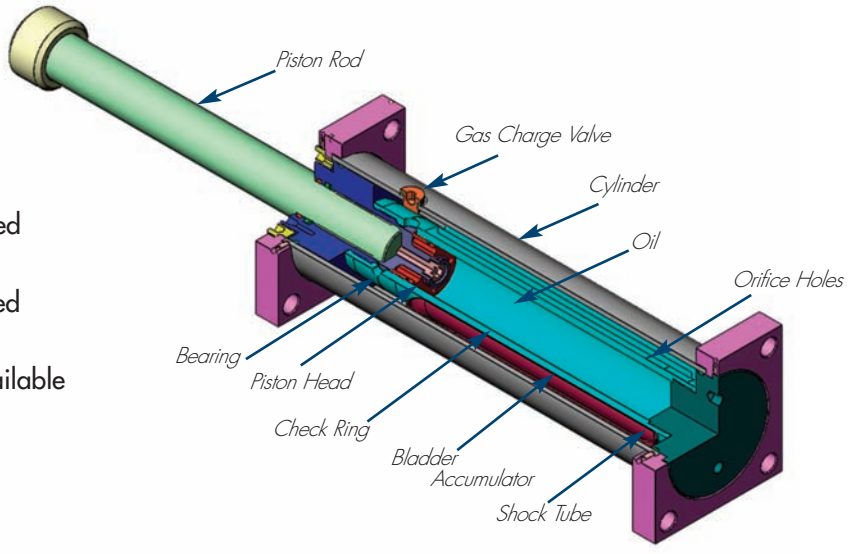
HD Series

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 5 in. (125mm) and 6 in. (156mm) with strokes over 60 in. (1525mm).



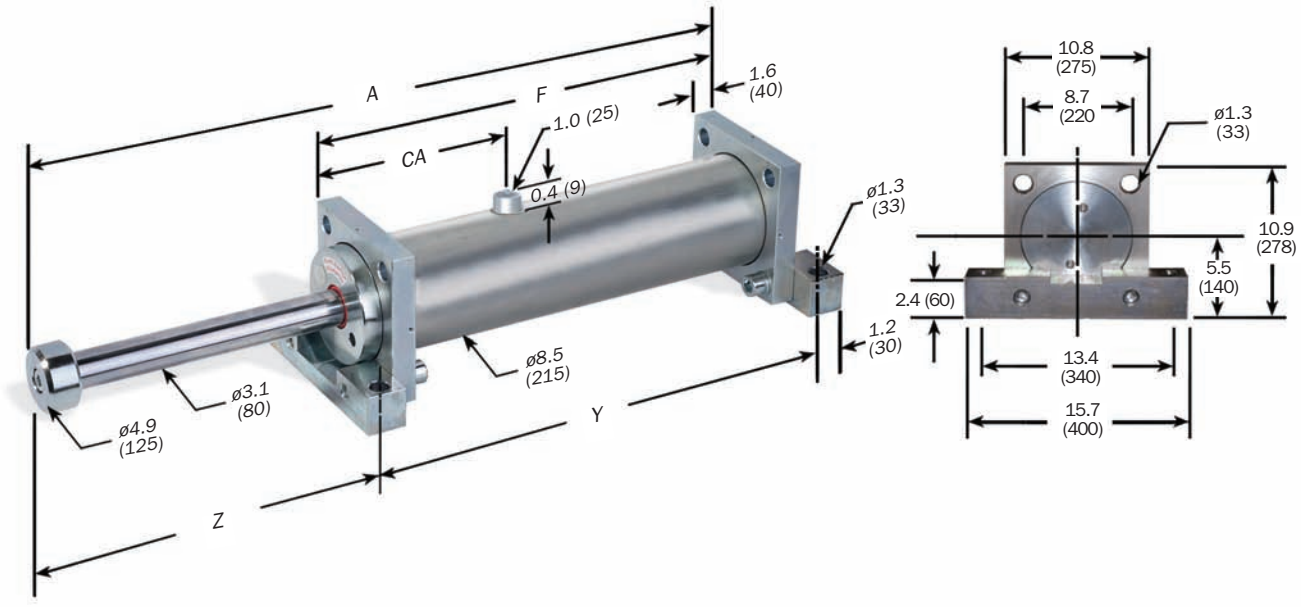
Features and Benefits HD

- Compact design smoothly and safely decelerates large energy capacity loads up to 8,000,000 in-lbs. per cycle (900 000 Nm)
- Engineered to meet OSHA, AISE, CMAA 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.
- Zinc plated external components provide enhanced corrosion protection.
- Epoxy painting and special rod materials are available for use in highly corrosive environments.
- All sizes are fully field repairable.
- Piston rod extension sensor systems available for reuse safety requirements.
- Incorporating optional fluids and seal packages can expand standard operating temperature range from 15°F to 140°F to -30°F to 210°F (-10°C to 60°C) to (-35°C to 100°C)



Technical Data

HD 5.0 x 4 HD 5.0 x 48 Series



Dimensions are in inches (millimeters).

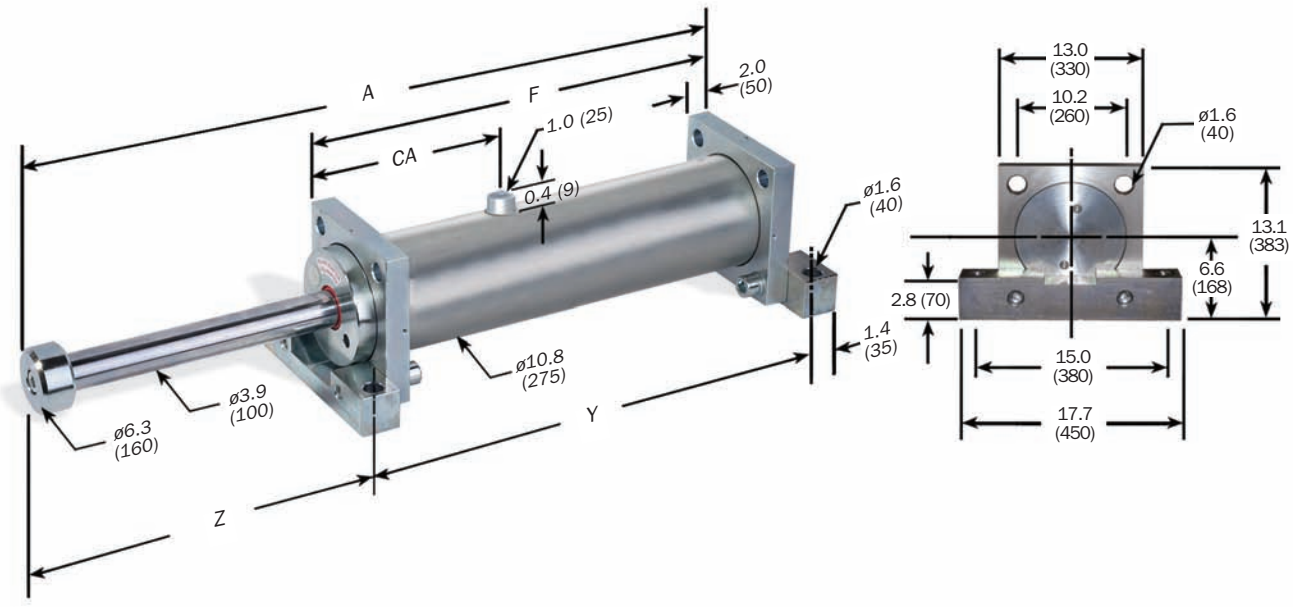
Note: For TF, FF and FR mounting, delete front foot and dimensions.

Catalog No./ Model	(S) Stroke in. (mm)	(E_T) Max. in.-lbs./cycle (Nm/cycle)	(E_TC) Max. in.-lbs./hour (Nm/hr)	(F_P) Max. Shock Force lbs. (N)	Nominal Return Force BA* lbs. (N)	A in. (mm)	F in. (mm)	Y in. (mm)	Z in. (mm)	CA in. (mm)	Model Weight lbs. (Kg)
HD 5.0 x 4	4 (100)	414,000 (46 700)	16,000,000 (1 762 621)	124,000 (550 000)	400 (1 760)	23.3 (591)	14.8 (37.5)	17.1 (435)	7.4 (186)	9.1 (230)	192 (87)
HD 5.0 x 6	6 (150)	620,000 (70 000)	17,720,000 (2 002 337)	124,000 (550 000)	400 (1 760)	27.3 (693)	16.8 (426)	19.1 (486)	9.4 (237)	9.1 (230)	207 (94)
HD 5.0 x 8	8 (200)	828,000 (93 500)	19,841,000 (2 242 053)	124,000 (550 000)	400 (1 760)	31.3 (795)	18.8 (477)	21.1 (537)	11.4 (288)	9.1 (230)	223 (101)
HD 5.0 x 10	10 (250)	1,036,000 (117 000)	21,921,000 (2 477 070)	124,000 (550 000)	400 (1 760)	35.3 (895)	20.8 (527)	23.1 (587)	13.4 (338)	9.1 (230)	238 (108)
HD 5.0 x 12	12 (300)	1,239,000 (140 000)	24,042,000 (2 716 786)	124,000 (550 000)	400 (1 760)	39.3 (997)	22.8 (578)	25.1 (638)	15.4 (389)	9.1 (230)	251 (114)
HD 5.0 x 16	16 (400)	1,655,000 (187 000)	28,285,000 (3 196 219)	124,000 (550 000)	400 (1 760)	47.3 (1 201)	26.8 (680)	29.1 (740)	19.4 (491)	9.1 (230)	282 (128)
HD 5.0 x 20	20 (500)	2,071,000 (234 000)	36,688,000 (4 145 684)	124,000 (550 000)	400 (1 760)	59.2 (1 504)	34.7 (882)	37.1 (942)	23.3 (592)	13.0 (230)	348 (158)
HD 5.0 x 24	24 (600)	2,478,000 (280 000)	40,930,000 (4 625 117)	124,000 (550 000)	400 (1 760)	67.2 (1 708)	38.7 (984)	41.1 (1 044)	27.3 (694)	13.0 (230)	377 (171)
HD 5.0 x 28	28 (700)	2,894,000 (327 000)	45,132,000 (5 099 849)	124,000 (550 000)	400 (1 760)	75.2 (1 910)	42.7 (1 085)	45.1 (1 145)	31.3 (795)	13.0 (230)	407 (185)
HD 5.0 x 32	32 (800)	3,310,000 (374 000)	49,374,000 (5 579 282)	124,000 (550 000)	400 (1 760)	83.2 (2 114)	46.7 (1 187)	49.1 (1 247)	35.3 (897)	13.0 (230)	437 (198)
HD 5.0 x 40	40 (1 000)	4,133,000 (467 000)	57,818,000 (6 533 447)	124,000 (550 000)	400 (1 760)	99.2 (2 520)	54.7 (1 390)	57.1 (1 450)	43.3 (1 100)	13.0 (231)	496 (225)
HD 5.0 x 48	48 (1 200)	4,750,000 (535 800)	66,262,000 (7 487 613)	92,000 (410 000)	400 (1 760)	115.0 (2 920)	62.6 (1 590)	65.0 (1 650)	51.6 (1 300)	13.0 (230)	534 (242)

Notes: 1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle.
HDA models will function satisfactorily at 10% 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 12 inch (300 mm) strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. Maximum cycle rate is 60 cycles/hr.
6. For impact velocities over 180 in./sec. (4.5 m/s), consult factory.

Heavy Duty Series Shock Absorber
HD 6.0 Series

HD 6.0 x 4 HD 6.0 x 48 Series



Dimensions are in inches (millimeters).

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

Catalog No./ Model	(S) Stroke in. (mm)	(E_T) Max. in.-lbs./cycle (Nm/cycle)	(E_TC) Max. in.-lbs./hour (Nm/hr)	(F_P) Max. Shock Force lbs. (N)	Nominal Return Force BA* lbs. (N)	A in. (mm)	F in. (mm)	Y in. (mm)	Z in. (mm)	CA in. (mm)	Model Weight lbs. (Kg)
HD(A) 6.0 x 4	4 (100)	677,000 (76 500)	21,280,000 (2 404 568)	202,250 (900 000)	625 (2 750)	25.1 (637)	15.4 (391)	18.2 (461)	8.3 (211)	7.8 (197)	362 (164)
HD(A) 6.0 x 6	6 (150)	1,010,000 (114 000)	23,933,000 (2 704 389)	202,250 (900 000)	625 (2 750)	29.1 (737)	17.4 (441)	20.2 (511)	10.3 (261)	7.8 (197)	386 (175)
HD(A) 6.0 x 8	8 (200)	1,354,000 (153 000)	26,586,000 (3 004 211)	202,250 (900 000)	625 (2 750)	33.1 (839)	19.4 (492)	22.2 (562)	12.3 (312)	7.8 (197)	410 (186)
HD(A) 6.0 x 10	10 (250)	1,690,000 (191 000)	29,345,000 (3 316 025)	202,250 (900 000)	625 (2 750)	37.1 (941)	21.4 (543)	24.2 (613)	14.3 (363)	7.8 (197)	432 (196)
HD(A) 6.0 x 12	12 (300)	1,982,000 (224 000)	32,052,000 (3 621 843)	202,250 (900 000)	625 (2 750)	41.1 (1 043)	23.4 (594)	26.2 (664)	16.3 (414)	7.8 (197)	456 (207)
HD 6.0 x 16	16 (400)	2,708,000 (306 000)	37,465,000 (4 233 478)	202,250 (900 000)	625 (2 750)	49.1 (1 246)	27.4 (696)	30.2 (766)	20.3 (515)	7.8 (197)	503 (228)
HD 6.0 x 20	20 (500)	3,380,000 (382 000)	42,877,000 (4 845 114)	202,250 (900 000)	625 (2 750)	57.1 (1 450)	31.4 (798)	34.2 (868)	24.3 (617)	7.8 (197)	551 (250)
HD 6.0 x 24	24 (600)	4,062,000 (459 000)	53,862,000 (6 086 375)	202,250 (900 000)	625 (2 750)	69.7 (1 769)	40.0 (1 015)	42.7 (1 085)	28.4 (719)	12.3 (312)	681 (309)
HD 6.0 x 30	30 (750)	5,070,000 (573 000)	61,928,000 (6 997 832)	202,250 (900 000)	625 (2 750)	81.6 (2 073)	46.0 (1 167)	48.7 (1 237)	34.3 (871)	12.3 (312)	752 (341)
HD 6.0 x 36	36 (900)	6,093,000 (688 500)	70,047,000 (7 915 285)	202,250 (900 000)	625 (2 750)	93.7 (2 379)	52.0 (1 320)	54.7 (1 390)	40.4 (1 024)	12.3 (312)	822 (373)
HD 6.0 X 42	42 (1 050)	7,106,000 (803 000)	78,113,000 (8 826 743)	202,250 (900 000)	625 (2 750)	105.6 (2 683)	58.0 (1 472)	60.7 (1 542)	46.3 (1 176)	12.3 (312)	893 (405)
HD 6.0 x 48	48 (1 200)	8,000,000 (898 200)	86,232,000 (9 744 196)	178,000 (750 000)	625 (2 750)	117.7 (2 989)	64.0 (1 625)	66.7 (1 695)	52.4 (1 329)	12.3 (312)	966 (438)

Notes: 1. HD shock absorbers will function satisfactorily at 5% of their maximum rated energy per cycle.
HDA models will function satisfactorily at 10% 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 12 inch (300 mm) strokes and longer not recommended. Front and rear flange or foot mount configurations are recommended.
5. HDA models which have an impact velocity below 30 in./sec. (.8 m/sec.), please contact Enidine for sizing assistance.
6. Maximum cycle rate is 60 cycles/hr.
7. For impact velocities over 180 in./sec. (4.5 m/s), consult factory.

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

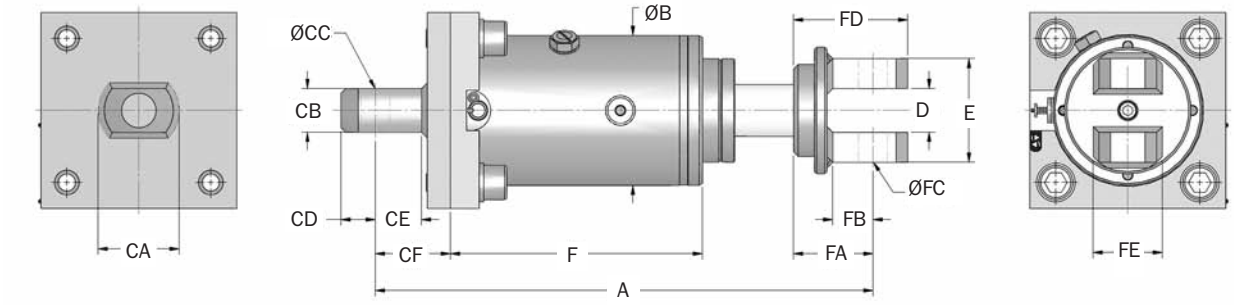
CM: Clevis Mount

FR: Rear Flange

Note: Rear flange mounting not recommended for stroke lengths above 12 inches. (300 mm)

HD(A) 3.0 x 2 → HD(A) 4.0 x 10 Series

Clevis Mounts (CM)



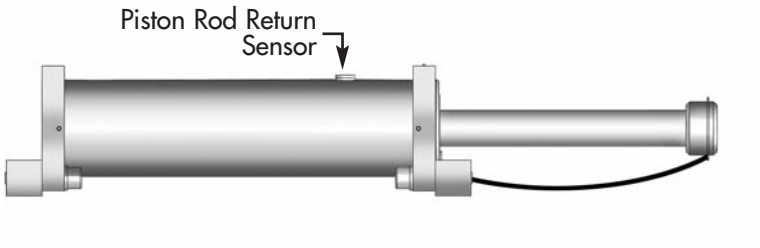
Dimensions are in inches (millimeters).

Note: Piston clevis dimensions are typical both ends on HD(A) 4.0 models.

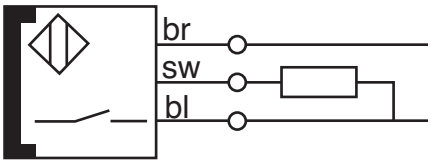
Catalog No./ Model	A in. (mm)	B in. (mm)	D in. (mm)	E in. (mm)	HD/HDN F in. (mm)	HDA F in. (mm)	Cylinder Clevis Dimensions						Piston Clevis Dimensions				
							CA in. (mm)	CB in. (mm)	CC in. (mm)	CD in. (mm)	CE in. (mm)	CF in. (mm)	FA in. (mm)	FB in. (mm)	FC in. (mm)	FD in. (mm)	FE in. (mm)
HD(A) 3.0 x 2	17.0 (432)	5.1 (130)	1.5 (38)	3.5 (90)	8.0 (202)	9.3 (235)	2.4 (60)	1.5 (38)	1.0 (25)	1.2 (30)	1.5 (37)	2.6 (65)	2.7 (69)	1.3 (32)	1.0 (25)	3.9 (99)	2.0 (50)
HD(A) 3.0 x 3	19.0 (483)	5.1 (130)	1.5 (38)	3.5 (90)	9.0 (229)	10.3 (261)	2.4 (60)	1.5 (38)	1.0 (25)	1.2 (30)	1.5 (37)	2.6 (65)	2.7 (69)	1.3 (32)	1.0 (25)	3.9 (99)	2.0 (50)
HD(A) 3.0 x 5	23.0 (585)	5.1 (130)	1.5 (38)	3.5 (90)	11.0 (280)	12.3 (312)	2.4 (60)	1.5 (38)	1.0 (25)	1.2 (30)	1.5 (37)	2.6 (65)	2.7 (69)	1.3 (32)	1.0 (25)	3.9 (99)	2.0 (50)
HD(A) 3.0 x 8	29.0 (736)	5.1 (130)	1.5 (38)	3.5 (90)	14.0 (355)	15.2 (387)	2.4 (60)	1.5 (38)	1.0 (25)	1.2 (30)	1.5 (37)	2.6 (65)	2.7 (69)	1.3 (32)	1.0 (25)	3.9 (99)	2.0 (50)
HD(A) 3.0 x 10	330 (838)	5.1 (130)	1.5 (38)	3.5 (90)	16.0 (406)	17.2 (438)	2.4 (60)	1.5 (38)	1.0 (25)	1.2 (30)	1.5 (37)	2.6 (65)	2.7 (69)	1.3 (32)	1.0 (25)	3.9 (99)	2.0 (50)
HD(A) 3.0 x 12	37.0 (940)	5.1 (130)	1.5 (38)	3.5 (90)	18.0 (457)	19.3 (489)	2.4 (60)	1.5 (38)	1.0 (25)	1.2 (30)	1.5 (37)	2.6 (65)	2.7 (69)	1.3 (32)	1.0 (25)	3.9 (99)	2.0 (50)
HD(A) 4.0 x 2	22.4 (570)	7.9 (200)	2.6 (65)	5.5 (140)	11.6 (294)	12.0 (304)	– –	– –	– –	– –	– –	3.5 (90)	3.9 (100)	2.4 (60)	2.0 (50)	5.9 (150)	3.9 (100)
HD(A) 4.0 x 4	26.4 (672)	7.9 (200)	2.6 (65)	5.5 (140)	13.6 (345)	14.0 (355)	– –	– –	– –	– –	– –	3.5 (90)	3.9 (100)	2.4 (60)	2.0 (50)	5.9 (150)	3.9 (100)
HD(A) 4.0 x 6	30.4 (772)	7.9 (200)	2.6 (65)	5.5 (140)	15.6 (395)	15.9 (405)	– –	– –	– –	– –	– –	3.5 (90)	3.9 (100)	2.4 (60)	2.0 (50)	5.9 (150)	3.9 (100)
HD(A) 4.0 x 8	34.4 (875)	7.9 (200)	2.6 (65)	5.5 (140)	17.6 (477)	18.0 (457)	– –	– –	– –	– –	– –	3.5 (90)	3.9 (100)	2.4 (60)	2.0 (50)	5.9 (150)	3.9 (100)
HD(A) 4.0 x 10	38.4 (976)	7.9 (200)	2.6 (65)	5.5 (140)	19.6 (497)	20.0 (507)	– –	– –	– –	– –	– –	3.5 (90)	3.9 (100)	2.4 (60)	2.0 (50)	5.9 (150)	3.9 (100)

Optional Piston Rod Return Sensor

- Magnetic proximity sensor indicates complete piston rod return with 10-foot (3 m) 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 port in line with charge port on models HDN 1.5, 2.0 and 4.0. Location offset 90° for models HDN 3.0 and 3.5.

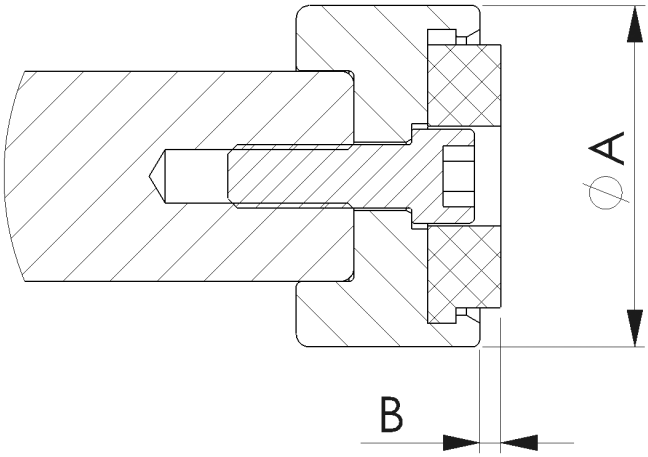


Sensor Specifications



- Voltage 10 - 30V
- Load Current ≤ 200 mA
- Leakage Current ≤ 80 mA
- Load Capacitance ≤ 1.0 mF
- Ambient Temperature: -15° to 160°F (-26° to 71°C)

Urethane Cap



Model	Dia. A (mm)	Dia A (in.)	B (mm)	B (in.)
HDN 1.5	60	2.36	4	0.16
HDN 2.0	65	2.56	4	0.16
HDN 3.0	70	2.76	4	0.16

Ordering Example

Note: HDN/HD/HDA models are custom-orificed, therefore all information must be provided to Enidine for unique part number assignment.

4	–	HDN	2.0	x	24	–	TM	–	C	–	APPLICATION DATA
1		2	3				4		5		

Ordering Code Example for Heavy Duty Shock Absorbers

1 - Quantity

2 - Model Selection
HDN (Non-Adjustable)
HD (Non-Adjustable)
HDA (Adjustable)

3 - Model Size
Select Size from Engineering Data Chart
HDN - 1.5, 2.0, 3.0, 3.5, 4.0 Bore Sizes (pages. 8-12)
HDA - 3.0, 4.0 Bore Sizes (pages. 13-14)
HD - 5.0, 6.0 Bore Sizes (pages. 16-17)

4 - Mounting Method
TM (Rear flange front foot mount)
FM (Front and rear foot mount)
TF (Front and rear flanges)
FF (Front flange)
FR (Rear flange)
CM (Metric clevis mount)

5 - Options
C (Sensor cable)
P (Sensor plug) - See Page 18
SC (Safety cable)
BA (Bladder Accumulator)
UC (Urethane Cap)

Application Data (Required for HDN/HD Models)
See Worksheet page 20
Vertical or horizontal motion
Weight
Impact velocity
Propelling force (if any)
Cycles/Hr
Other (temperature or other environmental conditions, safety standards, etc.)

Notes

Application Worksheet

FAX NO.: _____

DATE: _____

ATTN: _____

COMPANY: _____

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

Fax, phone, or mail worksheet data to Enidine headquarters or your nearest Enidine subsidiary/affiliate or distributor. (See catalog back cover for Enidine locations, or visit www.enidine.com for a list of Enidine distributors.)

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.)

GENERAL INFORMATION

CONTACT: _____

DEPT/TITLE: _____

COMPANY: _____

ADDRESS: _____

_____

TEL: _____ FAX: _____

EMAIL: _____

PRODUCTS MANUFACTURED: _____

_____

_____

_____

_____

APPLICATION DESCRIPTION

_____

_____

_____

_____

_____

_____

_____

_____

Motion Direction (Check One):

☐ Horizontal ☐ Vertical ☐ Up ☐ Down ☐ Incline Angle _____ Height _____

☐ Rotary Horizontal ☐ Rotary Vertical ☐ Up ☐ Down

Weight (Min./Max.): _____ (lbs.)(Kg)

Cycle Rate _____ (cycles/hour)

Additional Propelling Force (If Known) _____ (lbs.)(N)

☐ Air Cyl: Bore ____ (in.)(mm) Max. Pressure ____(psi)(bar) Rod Dia.____(in.)(mm)

☐ Hydraulic Cyl: Bore ____ (in.)(mm) Max. Pressure ____(psi)(bar)
Rod Dia.____ (in.)(mm)

☐ Motor _____ (hp)(kW) Torque _____(in-lbs.)(Nm)

Ambient Temp. _____ °F (°C)

Environmental Considerations: _____

_____

SHOCK ABSORBER APPLICATION (All Data Taken at Shock Absorber)

Number of Shock Absorbers to Stop Load

Impact Velocity (min./max.)_____ (in./sec.)(m/sec.)

Shock Absorber Stroke Requirements: _____(in.)(mm)

G Load Requirements _____(G)(m/sec^2)

APPLICATION SKETCHES / NOTES

ENIDINE

HEAVY DUTY SHOCK ABSORBERS

Applications:

- Control of bridge cranes
- Trolley platforms
- Large container transfer
- Automated aisle stacker cranes
- Cab operated bridge cranes
- Ship to shore container cranes
- Overhead bridge cranes
- Gantry cranes
- Ship to shore container cranes
- Transportation end stops

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