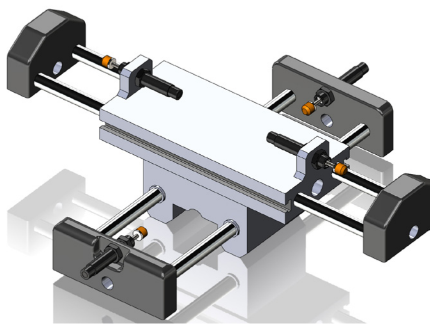
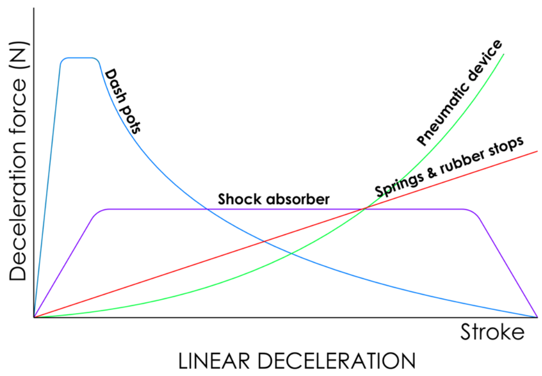


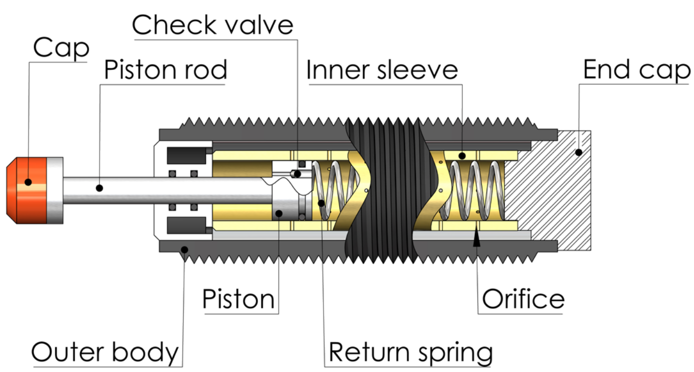
**Benefits of using WDS Industrial Shock Absorbers:**

- Increased productivity through raised machine speeds, smoother operation and operator comfort.
- Smooth deceleration of moving parts leading to reduced wear, lower noise and extended equipment life.
- Reduced maintenance, vibration and noise with benefits to health, safety and the working environment.
- WDS Industrial Shock Absorbers are maintenance free hydraulic deceleration devices, sealed for life.

Shock Absorbers are commonplace in industrial equipment where objects or components need to be decelerated or change direction. The kinetic energy in a moving body should be controlled and dissipated to avoid damage and wear to the equipment or excessive noise pollution. There are many device types to counter these issues but none can match the energy absorption characteristics of the hydraulic shock absorber when matched to the application.

**Deceleration technologies:**




- Dashpot - single unmetered orifice leads to high shock loads transferred to the machine at initial impact.
- Springs and rubber stops - transfer loads to the machine and store energy causing the load to rebound.
- Pneumatic device - sharply increasing force over the full stroke. The energy stored can cause rebound.

With the industrial shock absorber, motion resistance is created by the viscosity of the hydraulic oil as it is forced through small orifices. The output is heat, dissipated to the atmosphere. The result is increased efficiency and reduced noise.

Self-Compensating (AC): The WDS AC shock absorbers are of the double tube type in which hydraulic oil is forced though small orifices as the piston retract. The spacing and design of the orifices maintains a constant pressure on the piston throughout the full stroke leading to a near linear deceleration.

Adjustable (AD): The WDS AD shock absorbers have a single variable orifice connected to the adjuster wheel with a graduated scale. A few strokes after initial installation the unit can be adjusted to match the application. The scale enables return to previous settings but does not in itself relate to a force value. The adjuster can be locked using the key supplied.

**Adjustable or Self-Compensating?**

Choosing the most appropriate shock absorber depends on how predictable is the velocity, mass, propelling force and frequency of the object to be decelerated. Adjustable shock absorbers are ideal for situations where these factors remain constant as they can be set to match the Effective Mass (me) thus minimising any spike reaction force.

Conversely, Self-compensating shock absorbers will function within a range of Effective Mass (me). There are selection options for high, medium and low speed applications but no other adjustment is required for changes in mass, velocity or propelling force.

## Installation and mounting:

**Physical stop.**

WDS advise the use of a physical stop for the load, usually set at 90-95% of the shock absorber stroke.

This will prevent shock absorber damage caused by bottoming and provide a final rest position for the load.

**Mounting.**

WDS shock absorbers are all supplied with two locknuts to facilitate secure mounting to the application. Take care when designing the mounting arrangement to adequately support across the shock absorber piston centreline to avoid repeated bending or possible fatigue failure of the mount.

**Cushion caps.**

WDS shock absorbers are supplied with urethane rubber cushion caps installed as standard.

The cap can be simply removed by pulling with suitable hand tools or in the case of a metal supported cap the application of heat to the cap support will ease removal with hand tools.

**Painting and covering.**

Due to the heat generated and the need to dissipate heat to atmosphere the shock absorber should never be painted or covered which would prevent heat loss.

**In parallel and centre.**

Always install shock absorbers as close as possible to the centre of the load to be decelerated.

Only mount shock absorbers of the same rating and stroke in parallel and always evenly spaced to spread the load.

## Three steps to Shock Absorber selection:

**1. Determine:**

- Is the motion horizontal, vertical fall or rotary.
- Impact velocity & any propelling force.
- Mass to be decelerated within a defined stroke.
- Number of impact strokes per hour.

**2. Calculate:**

- W1 - the kinetic energy per stroke, mass only.
- W4 - the total energy per hour.
- me - the effective mass.

**3. Select:**

- Match the calculated values of W1, W4 and 'me' to the unit on the WDS product pages.

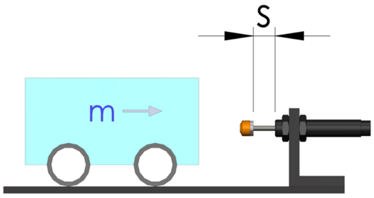
**Key to symbols:**

| | |
|---|---|
| W1 | Kinetic energy per stroke, mass only = m * $v^2$ / 2 (Nm) |
| W2 | Propelling energy or work per stroke = F * s (Nm) |
| W3 | Total energy per stroke = W1 + W2 (Nm) |
| W4 | Total energy per hour = W3 * x (Nm/hr) |
| P | Motor power (kW) |
| M | Propelling torque (Nm) |
| ST | Stall torque factor (usually 2.5) |
| g | Acceleration due to gravity = 9.81 ($m/s^2$) |
| me | Effective mass = 2*W3 / $v^2$ (kg) |
| h | Vertical drop distance excluding shock absorber stroke (m) |
| m | Mass to be decelerated (kg) |
| s | Shock absorber stroke (m) |
| n | Number of units in parallel |
| gs | Deceleration rate = 0.6 * $v^2$/g*s |
| v | Impact velocity at shock absorber (m/s) |
| u | Coefficient of friction |
| F | Propelling force (N) |
| Q | Reaction force = 1.2 * W3 / s (N) |
| x | Number of strokes per hour. |
| $\alpha$ | Angle of incline (degrees) |

Note: If multiple parallel units are ued, the values of W3,W4 and me are divided by the number of units used (n).

### Type 1
**Mass without propelling force**

Calculate W1, W3, W4 and 'me' using values m,v, and x




$$W1 = \frac{m*v^2}{2} = \frac{300*(1*1)}{2} = \frac{300}{2} = 150\ \text{Nm}$$

$$W3 = W1 \quad 150\ \text{Nm}$$

$$W4 = W1*x = 150 * 300 = 45{,}000\ \text{Nm/hr}$$

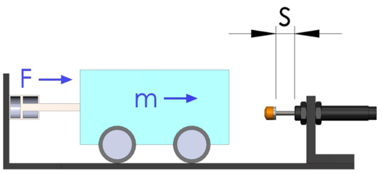
$$me = \frac{2*W1}{v^2} \quad \frac{2 * 150}{1*1} = \frac{300}{1} = 300\ \text{kg}$$

**Known Values**

m = 300 kg
v = 1m/s
x = 300/hr

### Type 2
**Mass with propelling force**

Calculate W1, W2, W3, W4 and 'me' using values m,v, s, F and x
In this instance force F will depend on method of propulsion and needs to be calculated separately




$$W1 = \frac{m*v^2}{2} = \frac{300*(1.2*1.2)}{2} = \frac{432}{2} = 216\ \text{Nm}$$

$$W2 = F*s = 3140*0.05 = 157\ \text{Nm}$$

$$W3 = W1 + W2 = 216+157 = 373\ \text{Nm}$$

$$W4 = W3*x = 373*300 = 111{,}900\ \text{Nm/hr}$$

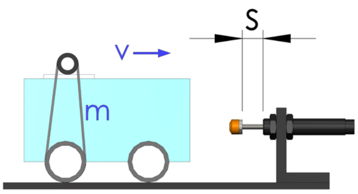
$$me = \frac{2*W3}{v^2} \quad \frac{2 * 373}{1.2*1.2} = \frac{746}{1.44} = 518\ \text{kg}$$

**Known Values**

F = 3140 N
m = 300 kg
v = 1.2 m/s
s = 0.05 metres
x = 300 /hr

### Type 3
**Mass with motor drive**

Calculate W1, W2, W3, W4 and 'me'using values m,v,s,F and x
In this instance F=P*ST/v




$$W1 = \frac{m*v^2}{2} = \frac{400*(1*1)}{2} = \frac{400}{2} = 200\ \text{Nm}$$

$$W2 = F*s = \frac{P*ST * s}{v} = \frac{1500*2.5}{1} *0.075 = 281\ \text{Nm}$$

$$W3 = W1 + W2 = 200+281 = 481.00\ \text{Nm}$$

$$W4 = W3*x = 481*60 = 28{,}860\ \text{Nm/hr}$$

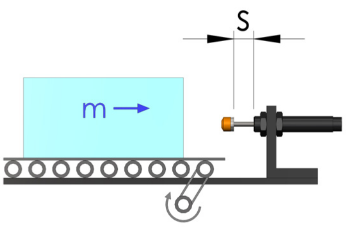
$$me = \frac{2*W3}{v^2} \quad \frac{2 * 481}{1*1} = \frac{962}{1} = 962\ \text{kg}$$

**Known Values**

m = 400 kg
v = 1 m/s
s = 0.075 metres
x = 60 /hr
P = 1500 w
ST = 2.5

### Type 4
**Mass on driven rollers**

Calculate W1, W2, W3, W4 and 'me' using values m,v,u,s,F and x
In this instance F=m*g*u




$$W2 = F*s = m*9.81*u*s = 7.4\ \text{Nm}$$

$$W3 = W1 + W2 = 18.75 + 7.4 = 26.1\ \text{Nm}$$

$$W4 = W3*x = 26.1*120 = 26.1\ \text{Nm}$$

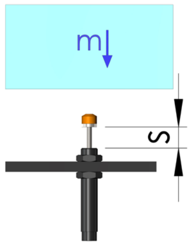
$$me = \frac{2*W3}{v^2} \quad \frac{2 * 26.1}{0.5*0.5} = \frac{52.2}{0.25} = 208.8\ \text{kg}$$

**Known Values**

v = 0.5 m/s
s = 0.02 metres
x = 120 /hr
u = 0.25

## Type 5
### Mass, vertical free fall

Calculate W1, W2, W3, W4 and 'me' using values m,v,h,s, F and x
In this instance v = √(2*g)*h and F=m*g



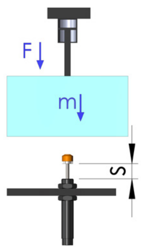

| | | | | | | |
|---|---|---|---|---|---|---|
| v = | sq.rt(2g*h) | = | sq.rt( 2*9.81* 0.4) | | = | 2.8 m/s |
| W1= | $\frac{m*v2}{2}$ | = | $\frac{40*(2.8*2.8)}{2}$ | = $\frac{313.6}{2}$ | = | 157 Nm |
| W2= | F*s | = | m*9.81*z*s | = 40*9.81*0.06 | = | 23.5 Nm |
| W3= | W1 + W2 | = | 157+23.5 | | = | 180.5 Nm |
| W4= | W3*x | = | 180.5*200 | | = | 36,100 Nm/hr |
| me = | $\frac{2*W3}{v^2}$ | | $\frac{2 * 180.5}{2.8*2.8}$ | = $\frac{361}{7.84}$ | = | 46.0 kg |

**Known Values**

- m = 40kg
- h = 0.4 m/s
- s = 0.06 m
- x = 200 /hr

## Type 6
### Mass, vertical with propelling force

Calculate W1, W2, W3, W4 and 'me' using values m,v, s, F and x
In this instance force F will depend on method of propulsion and needs to be calculated separately



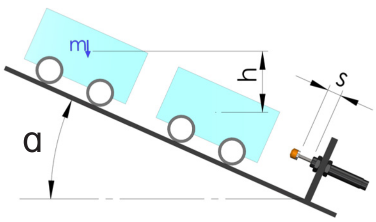

| | | | | | | |
|---|---|---|---|---|---|---|
| W1= | $\frac{m*v^2}{2}$ | = | $\frac{40*(1*1)}{2}$ | = $\frac{40}{2}$ | = | 20 Nm |
| W2= | F*s | = | 1373.65*0.025 | | = | 34.3 Nm |
| W3= | W1 + W2 | = | 20+34.3 | | = | 54.3 Nm |
| W4= | W3*x | = | 54.3*200 | | = | 10,860 Nm/hr |
| me= | $\frac{2*W3}{v^2}$ | = | $\frac{2 * 54.3}{1*1}$ | | = | 108.6 kg |

**Known Values**

- m = 40kg
- s = 0.025 m
- x = 200 /hr
- v = 1.0 m/s
- F = 1373.65 N

## Type 7
### Mass, free moving on inclined plane

Calculate W1, W2, W3, W4 and 'me' using values m,v,h,b, F,s and x
v = √(2*g)*h and F=(m*g)*sin α




| | | | | | | |
|---|---|---|---|---|---|---|
| v= | sq.rt(2g*h) | = | sq.rt( 2*9.81* 0.3) | | = | 2.43 m/s |
| W1= | $\frac{m*v^2}{2}$ | = | $\frac{150*(2.43*2.43)}{2}$ | = $\frac{885.735}{2}$ | = | 443 Nm |
| W2= | F*s | = | 150 * 9.81 * 0.075 * Sin30 | | = | 55.2 Nm |
| W3= | W1 + W2 | = | 443+55.2 | | = | 498.2 Nm |
| W4= | W3*x | = | 498.2*200 | | = | 99,640 Nm/hr |
| me = | $\frac{2*W3}{v^2}$ | | $\frac{2 * 498.2}{2.43*2.43}$ | = $\frac{996.4}{5.9}$ | = | 168.9 kg |

**Known Values**

- M = 150 kg
- h = 0.3 m/s
- s = 0.075 m
- x = 200 /hr
- α = 30°