

## 油壓緩衝器

決定油壓緩衝器的大小規格之前，我們必須知道下列四個參數

- 移動物體的總合重量  $m$  (kg)
- 撞擊瞬間速度  $v$  (m/s)
- 推進力  $F$  (N)
- 每小時的撞擊次數  $C$  (/hr)

### 常用的計算公式

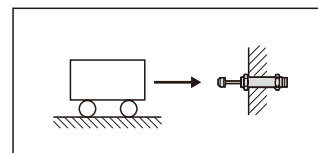
- 動能:  $E_k = mv^2/2$
- 驅動能量:  $E_D = F \times S$
- 自由落體速度:  $v = \sqrt{2g \times h}$
- 氣油壓缸的推進力:  $F = 0.00785 Pd^2$
- 最大衝擊力 (概估):  $F_m = 1.2 E_T/S$
- 電動馬達產生的推進力:  $F = 3000 \text{ kW}/v$
- 每小時吸收的總能量:  $E_{TC} = E_T \times C$

代號	單位	說明
$\mu$		摩擦係數
$\alpha$	(rad)	斜面傾斜角
$\theta$	(rad)	撞擊接觸行進角度
$\omega$	(rad/s)	角速度
A	(m)	寬度
B	(m)	厚度
C	(/hr)	每小時支撞擊次數
d	(mm)	氣缸內徑
$E_D$	(Nm)	驅動能量
$E_k$	(Nm)	動能
$E_T$	(Nm)	總合能量
$E_{TC}$	(Nm)	每小時總合能量
F	(N)	推進力
$F_m$	(N)	最大衝擊力
g	(m/s <sup>2</sup> )	重力加速度
h	(m)	高度
HM		馬達制動係數 (一般等於 2.5)
kW	(kW)	電動馬達功率
m	(kg)	移動物體的總合重量
$M_e$	(kg)	有效重量
P	(bar)	作動壓力
R	(m)	半徑
$R_s$	(m)	油壓緩衝器至旋轉中心的距離
S	(m)	行程
T	(Nm)	驅動扭力
t	(s)	減速時間
v	(m/s)	撞擊瞬間速度
$v_s$	(m/s)	緩衝器撞擊速度

### 計算例 1. 水平撞擊

#### 使用條件

$m = 300 \text{ kg}$   
 $v = 1.0 \text{ m/s}$   
 $S = 0.05 \text{ m}$   
 $C = 300 \text{ /hr}$



#### 公式及計算結果

$$E_k = \frac{mv^2}{2} = \frac{300 \times 1.0^2}{2} = 150 \text{ Nm}$$

$$E_T = E_k = 150 \text{ Nm}$$

$$E_{TC} = E_T \times C = 150 \times 300 = 45000 \text{ Nm/hr}$$

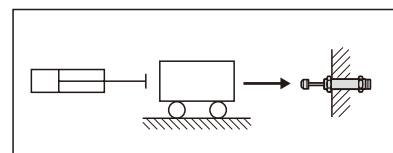
$$M_e = \frac{2E_T}{v^2} = \frac{2 \times 150}{1.0^2} = 300 \text{ kg}$$

由公式計算結果建議使用：  
**MDFC-3650 油壓緩衝器一支**

### 計算例 2. 有推進力之水平撞擊

#### 使用條件

$m = 50 \text{ kg}$   
 $v = 1.0 \text{ m/s}$   
 $S = 0.04 \text{ m}$   
 $F = 1000 \text{ N}$   
 $C = 500 \text{ /hr}$



#### 公式及計算結果

$$E_k = \frac{mv^2}{2} = \frac{50 \times 1.0^2}{2} = 25 \text{ Nm}$$

$$E_D = F \times S = 1000 \times 0.04 = 40 \text{ Nm}$$

$$E_T = E_k + E_D = 25 + 40 = 65 \text{ Nm}$$

$$E_{TC} = E_T \times C = 65 \times 500 = 32500 \text{ Nm/hr}$$

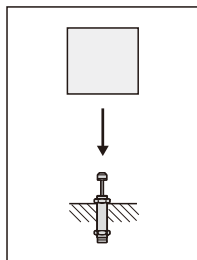
$$M_e = \frac{2E_T}{v^2} = \frac{2 \times 65}{1.0^2} = 130 \text{ kg}$$

由公式計算結果建議使用：  
**MDFC-2540 油壓緩衝器一支**

### 計算例 3. 自由落體

#### 使用條件

m = 30kg  
h = 0.5m  
S = 0.08m  
C = 300/hr



#### 公式及計算結果

$$v = \sqrt{2g \times h} = \sqrt{2 \times 9.81 \times 0.5} = 3.1 \text{ m/sec}$$

$$E_k = mg \times h = 30 \times 9.81 \times 0.5 = 147 \text{ Nm}$$

$$E_D = mg \times s = 30 \times 9.81 \times 0.08 = 23.5 \text{ Nm}$$

$$E_T = E_k + E_D = 147 + 23.5 = 170.5 \text{ Nm}$$

$$E_{TC} = E_T \times C = 170.5 \times 300 = 51150 \text{ Nm/hr}$$

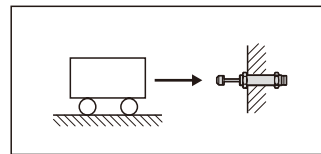
$$M_e = \frac{2E_T}{V^2} = \frac{2 \times 170.5}{3.1^2} = 35.5 \text{ kg}$$

由公式計算結果建議使用：  
MDSC-2580-1 油壓緩衝器一支

### 計算例 5. 馬達驅動之水平撞擊

#### 使用條件

m = 50 kg  
v = 1.5 m/s  
W = 2 kW  
HM = 2.5  
S = 0.06 m  
C = 100 /hr



#### 公式及計算結果

$$E_k = \frac{mv^2}{2} = \frac{300 \times 1.0^2}{2} = 150 \text{ Nm}$$

$$E_D = F \times S = \frac{\text{kW} \times \text{HM}}{v} \times S = \frac{2000 \times 2.5}{1.5} \times 0.06 = 200 \text{ Nm}$$

$$E_T = E_k + E_D = 56.25 + 200 = 256.25 \text{ Nm}$$

$$E_{TC} = E_T \times C = 256.25 \times 100 = 25625 \text{ Nm/hr}$$

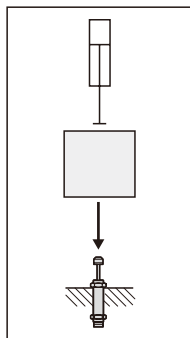
$$M_e = \frac{2E_T}{V^2} = \frac{2 \times 256.25}{1.5^2} = 227 \text{ kg}$$

由公式計算結果建議使用：  
MDSC-3660-2 油壓緩衝器一支

### 計算例 4. 有推進力之自由落體

#### 使用條件

m = 40 kg  
h = 0.3 m  
S = 0.025 m  
P = 5 bar  
d = 50 mm  
C = 200 /hr  
v = 1.0 m/sec



#### 公式及計算結果

$$E_k = \frac{mv^2}{2} = \frac{40 \times 1.0^2}{2} = 20 \text{ Nm}$$

$$E_D = F \times S = (mg + 0.0785Pd^2) \times S$$

$$= (40 \times 9.81 + 0.0785 \times 5 \times 50^2) \times 0.025 = 34.3 \text{ Nm}$$

$$E_T = E_k + E_D = 20 + 34.3 = 54.3 \text{ Nm}$$

$$E_{TC} = E_T \times C = 54.3 \times 200 = 10860 \text{ Nm/hr}$$

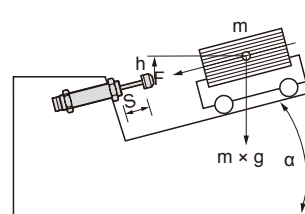
$$M_e = \frac{2E_T}{V^2} = \frac{2 \times 54.3}{1.0^2} = 108.6 \text{ kg}$$

由公式計算結果建議使用：  
MDFC-2525 油壓緩衝器一支

### 計算例 6. 傾斜撞擊

#### 使用條件

m = 30 kg  
h = 0.25 m  
S = 0.04 m  
 $\alpha = 30^\circ$   
C = 250 /hr



#### 公式及計算結果

$$v = \sqrt{2g \times h} = \sqrt{2 \times 9.81 \times 0.5} = 2.2 \text{ m/sec}$$

$$E_k = \frac{mv^2}{2} = \frac{30 \times 2.2^2}{2} = 72.6 \text{ Nm}$$

$$E_D = F \times S = m \times g \times S \times \sin \alpha$$

$$= 30 \times 9.81 \times 0.04 \times \sin 30^\circ = 5.9 \text{ Nm}$$

$$E_T = E_k + E_D = 72.6 + 5.9 = 78.5 \text{ Nm}$$

$$E_{TC} = E_T \times C = 78.5 \times 250 = 19625 \text{ Nm/hr}$$

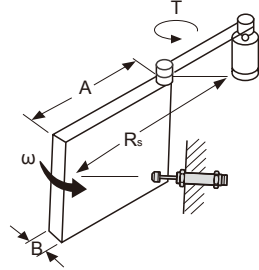
$$M_e = \frac{2E_T}{V^2} = \frac{2 \times 78.5}{2.2^2} = 32 \text{ kg}$$

由公式計算結果建議使用：  
MDSC-2540-1 油壓緩衝器一支

### 計算例 7. 水平旋轉門

#### 使用條件

$m = 20 \text{ kg}$   
 $\omega = 2.0 \text{ rad/s}$   
 $T = 20 \text{ Nm}$   
 $R_s = 0.8 \text{ m}$   
 $A = 1.0 \text{ m}$   
 $B = 0.05 \text{ m}$   
 $S = 0.016 \text{ m}$   
 $C = 100 \text{ /hr}$



#### 公式及計算結果

$$I = \frac{m(4A^2+B^2)}{12} = \frac{20(4 \times 1.0^2 + 0.05^2)}{12} = 6.67 \text{ kg}\cdot\text{m}^2$$

$$E_k = \frac{I\omega^2}{2} = \frac{6.67 \times 2.0^2}{2} = 13.34 \text{ Nm}$$

$$\theta = \frac{s}{R_s} = \frac{0.04}{0.8} = 0.05 \text{ rad}$$

$$E_D = T \times \theta = 20 \times 0.05 = 1.0 \text{ Nm}$$

$$E_T = E_k + E_D = 13.34 + 1.0 = 14.34 \text{ Nm}$$

$$E_{TC} = E_T \times C = 14.34 \times 100 = 1434 \text{ Nm/hr}$$

$$v = \omega \times R_s = 2.0 \times 0.8 = 1.6 \text{ m/s}$$

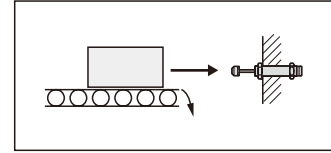
$$M_e = \frac{2E_T}{V^2} = \frac{2 \times 14.34}{1.6^2} = 11.20 \text{ kg}$$

由公式計算結果建議使用：  
MDFC-2016 油壓緩衝器一支

### 計算例 9. 水平動力輸送帶

#### 使用條件

$m = 150 \text{ kg}$   
 $v = 0.5 \text{ m/s}$   
 $\mu = 0.25$   
 $S = 0.02 \text{ m}$   
 $C = 120 \text{ /hr}$



#### 公式及計算結果

$$E_k = \frac{mv^2}{2} = \frac{150 \times 0.5^2}{2} = 18.75 \text{ Nm}$$

$$E_D = F \times S = mg\mu \times S = 150 \times 9.81 \times 0.25 \times 0.02 = 7.35 \text{ Nm}$$

$$E_T = E_k + E_D = 18.75 + 7.35 = 26.1 \text{ Nm}$$

$$E_{TC} = E_T \times C = 26.1 \times 120 = 3132 \text{ Nm/hr}$$

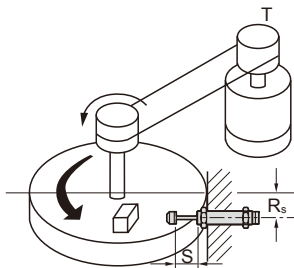
$$M_e = \frac{2E_T}{V^2} = \frac{2 \times 26.1}{0.5^2} = 208.8 \text{ kg}$$

由公式計算結果建議使用：  
MDSC-2020-3 油壓緩衝器一支

### 計算例 8. 有推進力之旋轉分度盤

#### 使用條件

$m = 200 \text{ kg}$   
 $\omega = 1.0 \text{ rad/s}$   
 $T = 100 \text{ Nm}$   
 $R = 0.5 \text{ m}$   
 $R_s = 0.4 \text{ m}$   
 $S = 0.04 \text{ m}$   
 $C = 100 \text{ /hr}$



#### 公式及計算結果

$$I = \frac{mR^2}{2} = \frac{200 \times 0.5^2}{2} = 25 \text{ kg}\cdot\text{m}^2$$

$$E_k = \frac{I\omega^2}{2} = \frac{25 \times 1.0^2}{2} = 12.5 \text{ Nm}$$

$$\theta = \frac{s}{R_s} = \frac{0.04}{0.4} = 0.1 \text{ rad}$$

$$E_D = T \times \theta = 100 \times 0.1 = 10 \text{ Nm}$$

$$E_T = E_k + E_D = 12.5 + 10 = 22.5 \text{ Nm}$$

$$E_{TC} = E_T \times C = 22.5 \times 50 = 1125 \text{ Nm/hr}$$

$$v = \omega \times R_s = 1.0 \times 0.4 = 0.4 \text{ m/s}$$

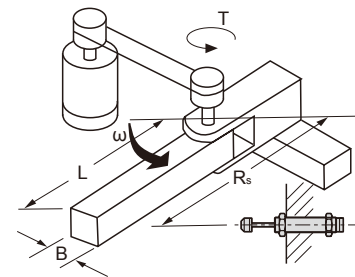
$$M_e = \frac{2E_T}{V^2} = \frac{2 \times 22.5}{0.4^2} = 281 \text{ kg}$$

由公式計算結果建議使用：  
MDFC-2540 油壓緩衝器一支

### 計算例 10. 有推動力之旋轉臂

#### 使用條件

$m = 40 \text{ kg}$   
 $A = 0.5 \text{ m}$   
 $B = 0.05 \text{ m}$   
 $\omega = 2.0 \text{ rad/s}$   
 $T = 10 \text{ Nm}$   
 $R_s = 0.4 \text{ m}$   
 $S = 0.05 \text{ m}$   
 $C = 50 \text{ /hr}$



#### 公式及計算結果

$$I = \frac{m(4A^2+B^2)}{12} = \frac{40(4 \times 0.5^2 + 0.05^2)}{12} = 3.34 \text{ kg}\cdot\text{m}^2$$

$$E_k = \frac{I\omega^2}{2} = \frac{3.34 \times 2.0^2}{2} = 6.7 \text{ Nm}$$

$$\theta = \frac{s}{R_s} = \frac{0.05}{0.4} = 0.125 \text{ rad}$$

$$E_D = T \times \theta = 10 \times 0.125 = 1.25 \text{ Nm}$$

$$E_T = E_k + E_D = 6.7 + 1.25 = 8 \text{ Nm}$$

$$E_{TC} = E_T \times C = 8 \times 50 = 400 \text{ Nm/hr}$$

$$v = \omega \times R_s = 2.0 \times 0.4 = 0.8 \text{ m/s}$$

$$M_e = \frac{2E_T}{V^2} = \frac{2 \times 8}{0.8^2} = 25 \text{ kg}$$

由公式計算結果建議使用：  
MDFC-2050 油壓緩衝器一支