

## Formulas/Calculation examples

Formula signs:

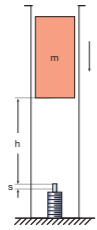
W1	kinetic energy per stroke; only mass load	[Nm]
W2	energy/working of driving power per stroke	[Nm]
W3	total energy per stroke (W1+W2)	[Nm]
W4	total energy per hour (8W3xh)	[Nm/h]
me	effective mass	[kg]
m	braking mass to be decelerated	[kg]
v	velocity of impact mass	[m/s]
v <sub>0</sub>	impact velocity at shock absorber	[m/s]
w	angle of incline	[1/s]
F	additional driving power	[N]
n	number of strokes per hour	[1/h]

P	motor capacity	[kW]
HM	arresting torque factor for motors 2,5	1 - 2,5
M	starting moment	[Nm]
J	mass moment of inertia	[kgm <sup>2</sup> ]
g	earth acceleration = 9,81	[m/s <sup>2</sup> ]
h	height of drop with impact damper stroke	[m]
s	impact damper stroke	[m]
L/R/r	radius	[m]
Q	reacting force/supporting force	[N]
u	coefficient of friction	
t	deceleration time	[s]
β	angle	[°]

For all samples valid:  $t = 2,6 \times s : v_0$  braking deceleration time (s)  
 $a = 0,6 \times v_0^2 : s$  retarding (m/s)

Attentione  
 For individual matter in case of damp environment we beg to contact our technical department: 07844/9138-0

### 1. Free falling Mass



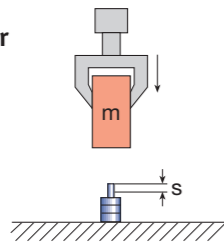
Example:  
 m=8kg  
 h=0,3m  
 n=120 1/h  
 s=0,02m

$W1 = m \times g \times h$	$W1 = 8 \times 9,81 \times 0,3$	23,5Nm
$W2 = m \times g \times s$	$W2 = 8 \times 9,81 \times 0,02$	1,6Nm
$W3 = W1 + W2$	$W3 = 23,544 + 1,5696$	25,1Nm
$W4 = W3 \times n$	$W4 = 25,136 \times 120$	3014Nm
$v_0 = \sqrt{2 \times g \times h}$	$v_0 = \sqrt{2 \times 9,81 \times 0,3}$	2,4m/s
$me = 2 \times W3 : v_0^2$	$me = 2 \times 25,136 : 2,43^2$	8,5kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 31Nm, W4 = 50 000Nm/h, v<sub>max</sub> = 2,0 - 5,0m/s)

M14 x 1.5S

### 2. Lowered mass without driving power



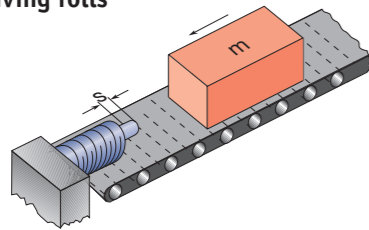
Example:  
 m=400kg  
 v=1m/s  
 n=30 1/h  
 s=0,02m

$W1 = 0,5 \times m \times v^2$	$W1 = 0,5 \times 400 \times 1^2$	200,0Nm
$W2 = m \times g \times s$	$W2 = 400 \times 9,81 \times 0,02$	78,5Nm
$W3 = W1 + W2$	$W3 = 200 + 78,48$	278,5Nm
$W4 = W3 \times n$	$W4 = 278,48 \times 30$	8354Nm
$v_0 = v$		1,0m/s
$me = 2 \times W3 : v_0^2$	$me = 2 \times 278,48 : 1^2$	557,0kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 320Nm, W4 = 120 000Nm/h, v<sub>max</sub> = 0,6 - 2,0m/s)

M33 x 1.5M

### 3. Mass on driving rolls



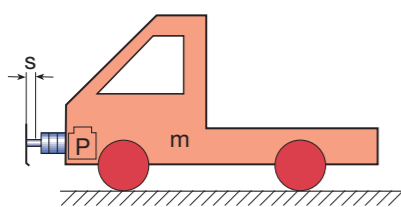
Example:  
 m=190kg  
 v=1,8m/s  
 n=170 1/h  
 s=0,025m  
 μ=0,2

$W1 = 0,5 \times m \times v^2$	$W1 = 0,5 \times 190 \times 1,8^2$	307,8Nm
$W2 = m \times \mu \times g \times s$	$W2 = 190 \times 0,2 \times 9,81 \times 0,025$	9,3Nm
$W3 = W1 + W2$	$W3 = 307,8 + 9,3195$	317,1Nm
$W4 = W3 \times n$	$W4 = 317,1195 \times 170$	53,910Nm
$v_0 = v$		1,8m/s
$me = 2 \times W3 : v_0^2$	$me = 2 \times 317,1195 : 1,8^2$	195,8kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 320Nm, W4 = 120 000Nm/h, v<sub>max</sub> = 0,6 - 2,0m/s)

M33 x 1.5M

### 4. Mass with motor driving



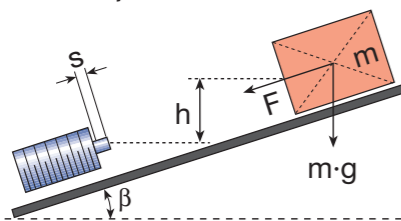
Example:  
 m=320kg  
 v=1,3m/s  
 n=80 1/h  
 s=0,025m  
 P=4 kW  
 HM=2,5

$W1 = 0,5 \times m \times v^2$	$W1 = 0,5 \times 320 \times 1,3^2$	270,4Nm
$W2 = 1000 \times P \times HM \times s : v$	$W2 = 1000 \times 4 \times 2,5 \times 0,025 : 1,3$	192,3Nm
$W3 = W1 + W2$	$W3 = 270,4 + 192,31$	462,7Nm
$W4 = W3 \times n$	$W4 = 462,71 \times 80$	37,017Nm
$v_0 = v$		1,3m/s
$me = 2 \times W3 : v_0^2$	$me = 2 \times 462,71 : 1,3^2$	547,6kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 650Nm, W4 = 150 000Nm/h, v<sub>max</sub> = 0,6 - 1,6m/s)

M45 x 1.5M

### 5. Mass on inclined plane



Example:  
 m=2kg  
 h=0,3m  
 n=120 1/h  
 s=0,08m  
 β=20°

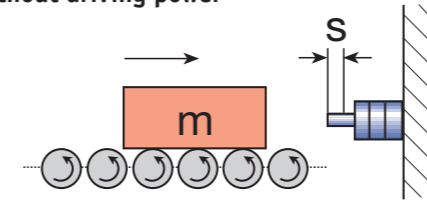
$W1 = m \times g \times h$	$W1 = 2 \times 9,81 \times 0,3$	5,9Nm
$W2 = m \times g \times s \times \sin \beta$	$W2 = 2 \times 9,81 \times 0,08 \times \sin 20$	0,5Nm
$W3 = W1 + W2$	$W3 = 5,89 + 0,54$	6,4Nm
$W4 = W3 \times n$	$W4 = 6,42 \times 120$	771Nm
$v_0 = \sqrt{2 \times g \times h}$	$v_0 = \sqrt{2 \times 9,81 \times 0,3}$	2,4m/s
$me = 2 \times W3 : v_0^2$	$me = 2 \times 6,42 : 2,43^2$	2,2kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 10Nm, W4 = 8 000Nm/h, v = 2,0 - 5,0m/s)

M10 x 1S

## Formulas/Calculation examples

### 6. Mass without driving power



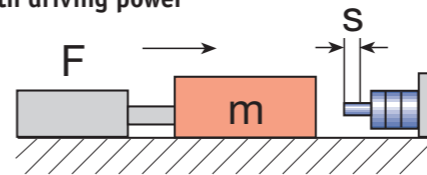
Example:  
 m=200kg  
 v=2,5m/s  
 n=120 1/h  
 s=0,025m

$W1 = 0,5 \times m \times v^2$	$W1 = 0,5 \times 200 \times 2,5^2$	625,0Nm
$W2 = 0$	$W2 = 0$	0,0Nm
$W3 = W1 + W2$	$W3 = 625 + 0$	625,0Nm
$W4 = W3 \times n$	$W4 = 625 \times 120$	75,000Nm
$v_0 = v$		2,5m/s
$me = m$		200,0kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 650Nm, W4 = 150 000Nm/h, v = 1,4 - 3,5m/s)

M45 x 1.5S

### 7. Mass with driving power



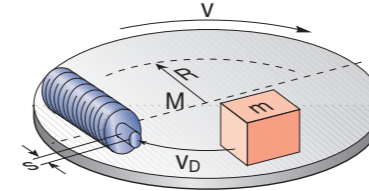
Example:  
 m=30kg  
 v=1,9m/s  
 n=800 1/h  
 s=0,025m  
 F=300N

$W1 = 0,5 \times m \times v^2$	$W1 = 0,5 \times 30 \times 1,9^2$	54,2Nm
$W2 = F \times s$	$W2 = 300 \times 0,025$	7,5Nm
$W3 = W1 + W2$	$W3 = 54,15 + 7,5$	61,7Nm
$W4 = W3 \times n$	$W4 = 61,65 \times 800$	49,320Nm
$v_0 = v$		1,9m/s
$me = 2 \times W3 : v_0^2$	$me = 2 \times 61,65 : 1,9^2$	34,2kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 70Nm, W4 = 63 000Nm/h, v = 1,8 - 4,5m/s)

M20 x 1.5S

### 8. Rotating table with driving moment horizontal and vertical



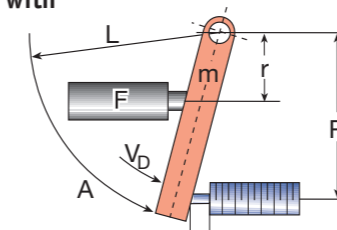
Example:  
 m=650kg  
 v=1,2m/s  
 n=90 1/h  
 s=0,02m  
 R=0,9m  
 M=1200Nm  
 L=1,35m

$W1 = 0,25 \times m \times v^2$	$W1 = 0,25 \times 650 \times 0,8^2$	234,0Nm
$= 0,5 \times J \times \omega^2$		
$W2 = M \times s : R$	$W2 = 650 \times 0,02 : 0,9$	14,4Nm
$W3 = W1 + W2$	$W3 = 234 + 14,44$	248,4Nm
$W4 = W3 \times n$	$W4 = 248,44 \times 90$	22,360Nm
$v_0 = v \times R : L$	$v_0 = 1,2 \times 0,9 : 1,35$	0,8m/s
$= \omega \times R$		
$me = 2 \times W3 : v_0^2$	$me = 2 \times 248,44 : 0,8^2$	776,4kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 320Nm, W4 = 120 000Nm/h, v = 0,2 - 0,8m/s)

M33 x 1.5H

### 9. Swivelling mass with driving power



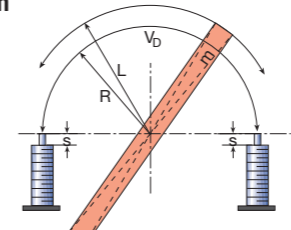
Example:  
 m=320kg  
 v=3m/s  
 n=220 1/h  
 s=0,025m  
 R=0,9m  
 M=3200Nm  
 L=1,5m  
 F=6000N  
 r=0,7m

$W1 = m \times v^2 \times 0,17$	$W1 = 320 \times 1,8^2 \times 0,17$	489,6Nm
$= 0,5 \times J \times \omega^2$		
$W2 = F \times r \times s : R$	$W2 = 6000 \times 0,7 \times 0,025 : 0,9$	116,7Nm
$= M \times s : R$		
$W3 = W1 + W2$	$W3 = 489,6 + 116,67$	606,3Nm
$W4 = W3 \times n$	$W4 = 606,27 \times 220$	133,379Nm
$v_0 = v \times R : L$	$v_0 = 3 \times 0,9 : 1,5$	1,8m/s
$= \omega \times R$		
$me = 2 \times W3 : v_0^2$	$me = 2 \times 606,27 : 1,8^2$	374,2kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 650Nm, W4 = 150 000Nm/h, v = 1,4 - 3,5m/s)

M45 x 1.5S

### 10. Swivelling mass with driving power



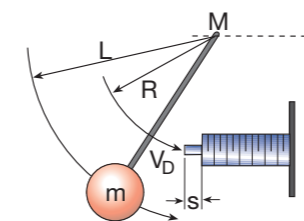
Example:  
 J=41kgm<sup>2</sup>  
 w=2 1/s  
 n=900 1/h  
 s=0,025m  
 R=0,9m  
 M=400Nm  
 L=1,8m

$W1 = m \times v^2 \times 0,17$	$W1 = 0,5 \times 41 \times 2^2$	82,0Nm
$= 0,5 \times J \times \omega^2$		
$W2 = F \times r \times s : R$	$W2 = 400 \times 0,025 : 0,9$	11,1Nm
$= M \times s : R$		
$W3 = W1 + W2$	$W3 = 82 + 11,11$	93,1Nm
$W4 = W3 \times n$	$W4 = 93,11 \times 900$	83,800Nm
$v_0 = v \times R : L$	$v_0 = 2 \times 0,9$	1,8m/s
$= \omega \times R$		
$me = 2 \times W3 : v_0^2$	$me = 2 \times 93,11 : 1,8^2$	57,5kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 210Nm, W4 = 95 000Nm/h, v = 1,4 - 4,0m/s)

M25 x 1.5S

### 11. Swivelling mass with driving moment



Example:  
 m=12kg  
 v=1,5m/s  
 n=1600 1/h  
 s=0,02m  
 R=0,6m  
 M=60Nm  
 L=0,9m

$W1 = m \times v^2 \times 0,5$	$W1 = 0,5 \times 12 \times 1,5^2$	13,5Nm
$= 0,5 \times J \times \omega^2$		
$W2 = M \times s : R$	$W2 = 60 \times 0,02 : 0,6$	2,0Nm
$W3 = W1 + W2$	$W3 = 13,5 + 2$	15,5Nm
$W4 = W3 \times n$	$W4 = 15,5 \times 1600$	24,800Nm
$v_0 = v \times R : L$	$v_0 = 1,5 \times 0,6 : 0,9$	1,0m/s
$= \omega \times R$		
$me = 2 \times W3 : v_0^2$	$me = 2 \times 15,5 : 1^2$	31,0kg

selection with W3, W4 und v<sub>0</sub>  
 (W3 = 16Nm, W4 = 30 000Nm/h, v = 0,2 - 1,4m/s)

M12 x 1H