Kinetrol Dashpot Overview

Rotary Dashpots

Kinetrol rotary dashpots
Kinetrol rotary dashpots are precision fluid damping devices which give a smooth resistance to shaft rotation which increases with angular velocity. Two types of dashpot are available to suit a wide range of applications.

- **Vane dashpots**
  Vane dashpots give a restricted travel and high damping rate suitable for applications with reciprocating motions.

- **Continuous rotation dashpots**
  Continuous rotation dashpots give less damping rate but unlimited travel.

Silicone Fluid (Polydimethyl Siloxane - DC200 or equivalent)
Silicone fluid is used as the damping medium because of its stable viscous properties. Daspots are normally vacuum filled and sealed for life.

Rigorous 100% inspection
Kinetrol's rigorous quality programme, approved to ISO 9001, ensures that each unit is manufactured to high standards. Every dashpot is tested to ensure that it gives the specified rate.

Certificate No. FM22163

Vane Dashpots

Angle of travel:

60°	(model KD)
215°	(model LA)
220°	(model LE)
220°	(model LH)
220°	(model LX)
240°	(model LB)

Maximum torque:

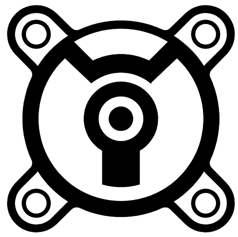
28 Nm	(model KD)
40 Nm	(model LA)
160 Nm	(model LB)
545 Nm	(model LE)
640 Nm	(model LX)
960 Nm	(model LH)

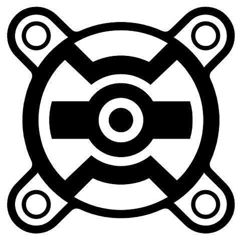
Maximum rate:

450 Nm/rad/s	(model KD)
300 Nm/rad/s	(model LA)
400 Nm/rad/s	(model LB)
12000 Nm/rad/s	(model LE)
18000 Nm/rad/s	(model LX)
18000 Nm/rad/s	(model LH)

Adjustable versions available

The vane dashpot is a displacement damper. As the vane on the shaft rotates between fixed vanes on the body, silicone fluid is displaced through controlled clearances from one side of the vane to the other. Damping can be in both directions or valves can be fitted to give damping in one direction only. On the KD unit, shaft sealing is by a cylindrical rubber seal which is bonded both to the shaft and to the body to give a hermetic seal. All other vane dashpots use a lip seal.





Continuous Rotation Dashpots

Unlimited travel

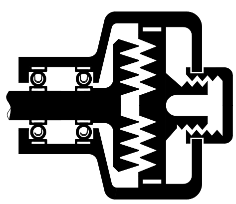
Maximum torque:

0.4 Nm	(model N-CRD)
1.5 Nm	(model Q-CRD)
6 Nm	(model X-CRD)
7 Nm	(model S-CRD)
45 Nm	(model T-CRD)

Effective rate:
up to 20 Nm/rad/s (T–CRD)

Adjustable versions available

Continuous rotation dashpots give viscous damping by shearing thin layers of silicone fluid between the concentric surfaces of a rotor and a fixed stator. Damping is normally in both directions. The shaft is sealed with a lip seal. Damping is adjusted by varying the effective thickness of the sheared layer of fluid by moving the stator relative to the rotor.



Kinetrol Dashpot Overview

General Notes

- For calculation purposes the rotation speed of the dashpot is given in RADIANS per second (1 radian = 57.3°). The significance of a radian is that if, for example, a 1 metre radius lever rotates through 1 radian, the end of the lever moves 1 metre, a distance equal to the radius.

- Damping RATE is defined here as TORQUE divided by ROTATION SPEED. Note that a dashpot with a high rate may not necessarily be working at a high torque. For example, may have a rate of 100 Nm/rad/s; however, it may be rotated at 1/10 rad/s so that the damping torque produced is 10 Nm which is not numerically equal to the rate.

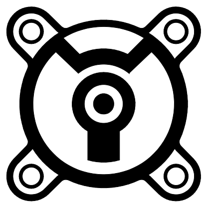
Dashpot Selection

- To select a suitable dashpot for an application, the suggested procedure is to first establish the RATE required. Most applications can be reduced to one of the cases shown. Please see calculations data sheet.

- Having established the rate required, the type of dashpot (vane or continuous rotation) must be selected. This usually depends on the angle of travel required.

- It is recommended that initially an adjustable dashpot is used in an application. This allows the exact damping rate to be established. Subsequent units can then be supplied with fixed rates based on measurement of the adjustable unit as set on the application.

Vane Dashpots - (High rate, restricted travel)

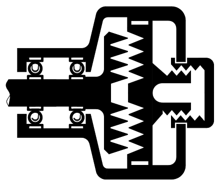


- Establish the rate from the formula. Please see calculations data sheet.

- Check that the maximum shaft torque does not exceed the maximum allowable. Note that max. torque = RATE x max. speed of rotation.

- For a vane dashpot the RATE does not vary much with speed and so can be used to specify the unit.

Continuous Rotation Dashpots - (Lower rate, unlimited travel)



- Establish the rate from the formula. Please see calculations data sheet.

- Calculate the working speed w in radians/sec.

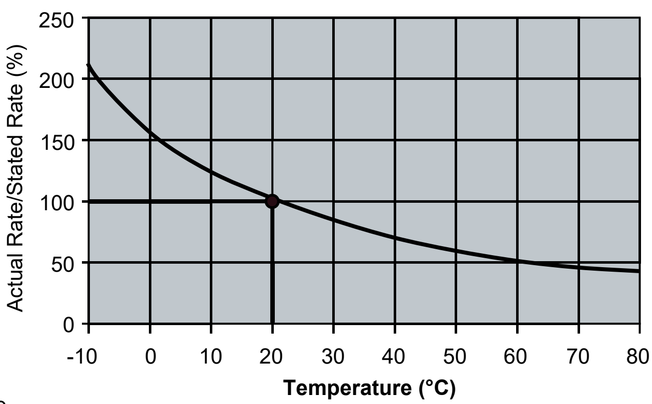
- Calculate the working torque (RATE x working speed of rotation).

- The rate of a CR dashpot is not constant. It varies with speed. This is because at the high shear rates used by this method of damping the viscosity of the fluid is not constant (Non-Newtonian). The performance of a CR dashpot is thus not specified by a single rate but is specified by a graph showing torque against speed of rotation.

- To select a CR dashpot plot the required working torque against the speed on the graph given on the data sheet. The nearest curve above the point gives the selected dashpot.

Temperature Effects

Damping rate is reduced by increases in fluid temperature (and increased by reduction in temperature). The graph opposite indicates the percentage change in damping rate with temperature, relative to the rate quoted at 20°C (68°F).



Dashpots compensated for temperature change, to keep damping rate constant, can be supplied to special order.

In addition to the effect of ambient temperature, heating of the dashpot above ambient is caused by the power absorbed by the damping action. Power dissipation limits are given for 20°C (68°F) ambient. At temperatures above 20°C (68°F) these power limits are derated by a factor:

$$(T_L - T_A) / (T_L - 20)$$

where T_L = Limit Temperature and T_A = Ambient Temperature.

Provision is made for temperature expansion of the fluid and no topping up is required during the life of the dashpot.

Kinetrol Dashpot Technical - Dashpot Sizing

General Notes

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- Having established the rate required, the type of dashpot (vane or continuous rotation) must be selected. This usually depends on the angle of travel required.

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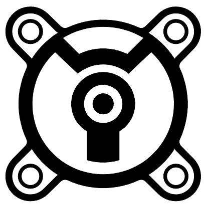
Vane Dashpots - (High rate, restricted travel)

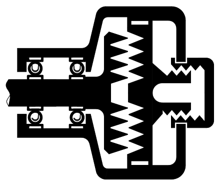


- Establish the rate from the formula. Please see calculations data sheet.

- Check that the maximum shaft torque does not exceed the maximum allowable. Note that max. torque = RATE x max. speed of rotation.

- For a vane dashpot the RATE does not vary much with speed and so can be used to specify the unit.

Continuous Rotation Dashpots - (Lower rate, unlimited travel)



- Establish the rate from the formula. Please see calculations data sheet.

- Calculate the working speed w in radians/sec.

- Calculate the working torque (RATE x working speed of rotation).

- The rate of a CR dashpot is not constant. It varies with speed. This is because at the high shear rates used by this method of damping the viscosity of the fluid is not constant (Non-Newtonian). The performance of a CR dashpot is thus not specified by a single rate but is specified by a graph showing torque against speed of rotation.

- To select a CR dashpot plot the required working torque against the speed on the graph given on the data sheet. The nearest curve above the point gives the selected dashpot.

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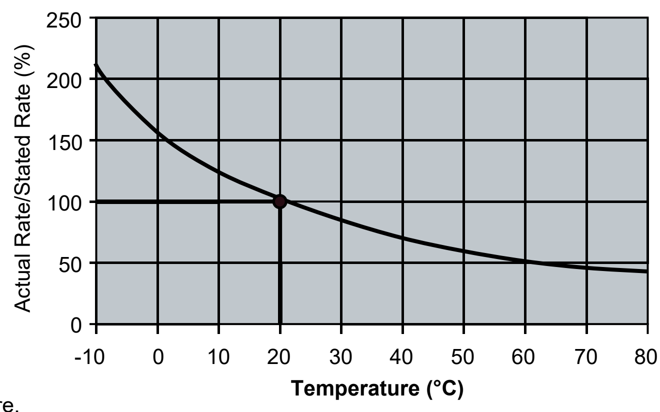
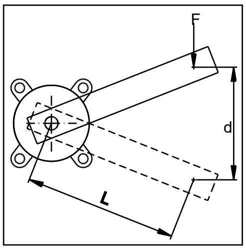


Kinetrol Dashpot Calculations - Calculating Damping Rates

Metric Units

Given quantity and unit

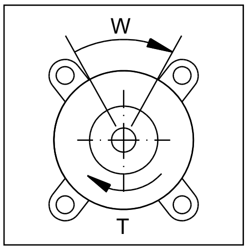
F	N	=	force of weight on end of lever	**t**	s	=	time taken to move this distance	**M**	kg	=	mass
L	m	=	effective length of lever	**w**	rad/s	=	speed of rotation	**V**	m/s	=	velocity of mass
d	m	=	distance moved by end of lever	**T**	Nm	=	torque applied to shaft	**f**	Hz	=	frequency of vibration



1 Steady movement in a straight line.

Required rate:

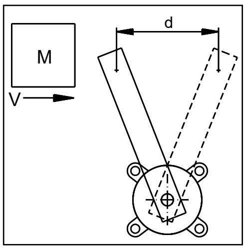
$$= \frac{FL^2t}{d} \text{ Nm/rad/s}$$



2 Steady rotation.

Required rate:

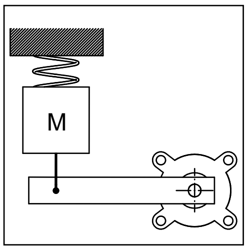
$$= \frac{T}{w} \text{ Nm/rad/s}$$



3 Deceleration of mass moving in a straight line.

Required rate:

$$= \frac{MVL^2}{d} \text{ Nm/rad/s}$$



4 Critical damping of vibrating mass.

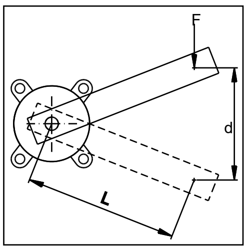
Required rate:

$$= \frac{MfL^2}{0.08} \text{ Nm/rad/s}$$

English Units

Given quantity and unit

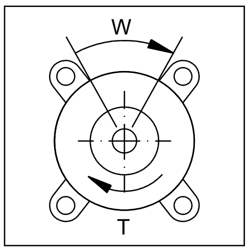
F	lbf	=	force of weight on end of lever	**t**	s	=	time taken to move this distance	**M**	lbf	=	mass
L	in	=	effective length of lever	**w**	rad/s	=	speed of rotation	**V**	in/s	=	velocity of mass
d	in	=	distance moved by end of lever	**T**	lbf.ins	=	torque applied to shaft	**f**	Hz	=	frequency of vibration



1 Steady movement in a straight line.

Required rate:

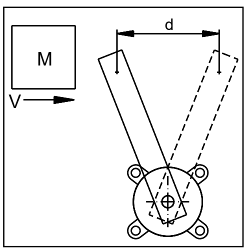
$$= \frac{FL^2t}{d} \text{ lbf.ins/rad/s}$$



2 Steady rotation.

Required rate:

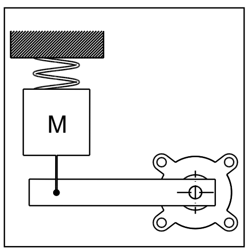
$$= \frac{T}{w} \text{ lbf.ins/rad/s}$$



3 Deceleration of mass moving in a straight line.

Required rate:

$$= \frac{MVL^2}{386d} \text{ lbf.ins/rad/s}$$



4 Critical damping of vibrating mass.

Required rate:

$$= \frac{MfL^2}{30.7} \text{ lbf.ins/rad/s}$$

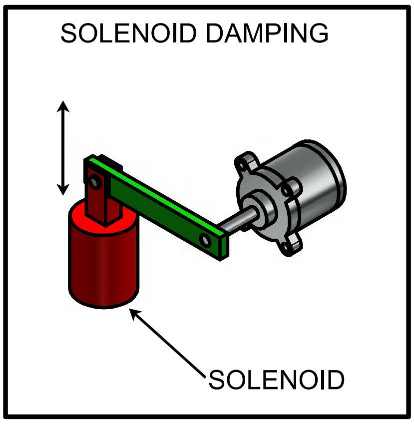
Conversion factors

1 rad	=	57.3°	1 RPM	=	0.1047 rad/s	1 lbf.ins	=	0.113 Nm			
1 Nm	=	8.85 lbf.ins	1 lbf	=	4.45 N	9.81 N	=	1 kgf	=	1 kp	

Kinetrol Dashpot Calculations - Calculating Damping Rates

Sample Calculations

Solenoid Damping



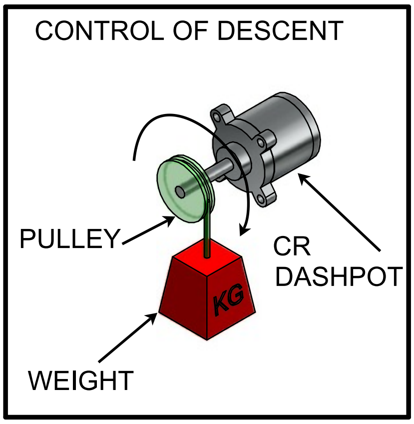
Solenoid force **F** = 10 N
Solenoid travel **d** = 25 mm = 0.025 m
Lever arm length **L** = 75 mm = 0.075 m
Travel time required **t** = 5 s

Use Formula 1: Rate $= \frac{FL^2t}{d} = \frac{10 \times 0.075^2 \times 5}{0.025}$

= 11.2 Nm/rad/s (99 lbf.Ins/rad/s)

Conclusion: Use KD – A2

Control of Descent



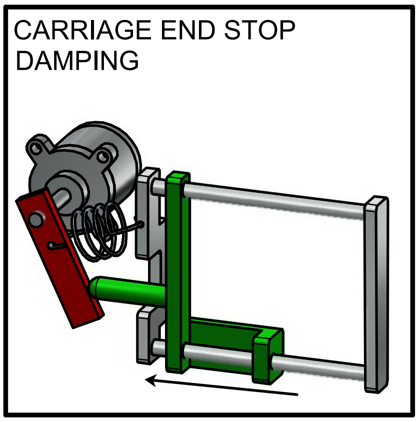
Weight = 1 kg
Pulley radius = 50 mm = 0.05 m
Speed required **V** = 100 mm/s = 0.1 m/s
Force **F** = 1 x 9.81 = 9.81 N
Torque **T** = 9.81 x 0.05 = 0.49 Nm
Speed of rotation **w** = 0.1 m/s ÷ 0.05 m = 2 rad/s

Use Formula 2: Rate = T/w = 0.49/2 = 0.245 Nm/rad/s

This is a CR dashpot application. Find point on the S – CRD graph for torque and speed

Conclusion: Use S – CRD – 30,000

Carriage Mechanism End Stop Damping



Carriage mass **M** = 10 kg
Velocity **V** = 1 m/s
Deceleration distance **d** = 50 mm = 0.05 m
Lever length **L** = 75 mm = 0.075 m

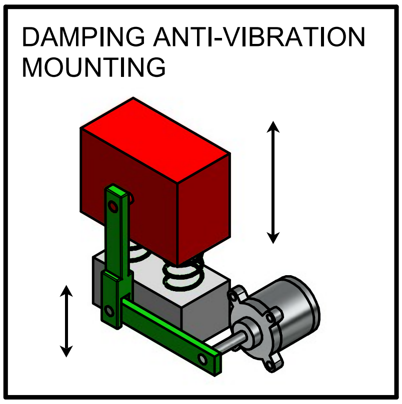
Use Formula 3: Rate $= \frac{MVL^2}{d} = \frac{10 \times 1 \times 0.075^2}{0.05}$

= 1.1 Nm/rad/s (9.7 lbf.Ins/rad/s)

Check max. rotation speed = 1 m/s ÷ 0.075 m = 13.3 rad/s
Hence max. torque = 13.3 x 1.1 = 14.7 Nm (130 lbf.Ins)

Conclusion: Use KD – A1

Damping Anti-Vibration Mounting



Mass **M** = 10 kg
Natural frequency **f** = 20 Hz
Lever length **L** = 100 mm = 0.10 m

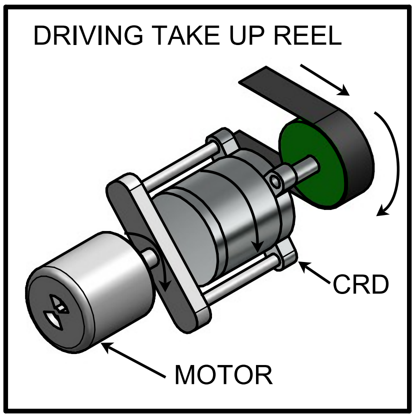
Use Formula 4: Rate $= \frac{MfL^2}{0.08} = \frac{10 \times 20 \times 0.1^2}{0.08}$

= 25 Nm/rad/s (220 lbf.Ins/rad/s)

Conclusion: Use KD – A3

Kinetrol Dashpot Calculations - Calculating Damping Rates

Notes on Constant Tension Take Up Reel



A CR dashpot can be used as a slipping drive between a geared motor and a take up reel for winding tape or wire on to a reel. If sized correctly the tension in the tape can be maintained within reasonable limits for a ratio of maximum to minimum reel radius of up to 2.5. Difficulty sometimes arises because it is necessary to select the correct motor speed as well as dashpot rate.

Suggested Procedure

Given:	Tape linear speed **V**	m/s
	Required tension **f**	N
	Minimum reel radius **a**	m
	Maximum reel radius **b**	m

Required motor speed **n** = 13 V/a rpm

Required damping rate **k** = $\frac{400\,f\,V}{n^2}$ Nm/rad/s

CR dashpot must give torque $\frac{0.4\,k\,V}{a}$

At a speed of 0.4 V/a rad/s.

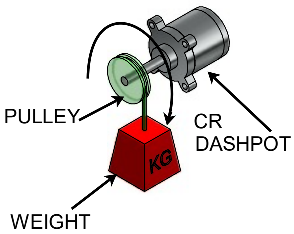
Check max. Power dissipated = $k(0.1n - V/b)^2$ W

This must be less than 10W for S – CRD and 40W for T – CRD.

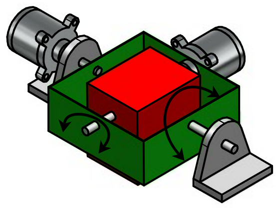
Kinetrol Dashpot Applications

Sketches Showing Some Application Ideas

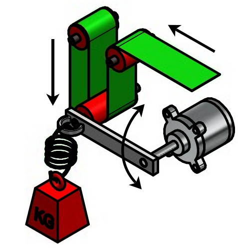
CONTROL OF DESCENT



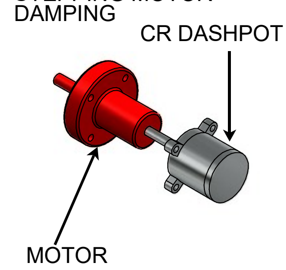
DAMPING GIMBALS



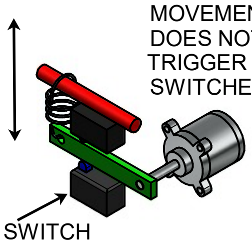
TENSION ROLLER DAMPING



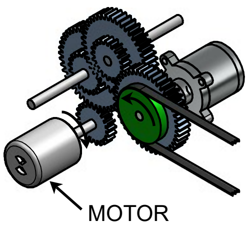
STEPPING MOTOR DAMPING



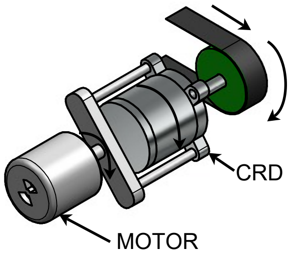
VEHICLE LEVEL SENSOR



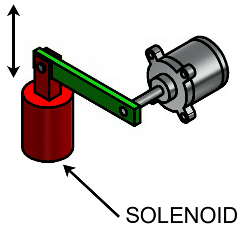
DAMPING GEAR TRAIN VIBRATION



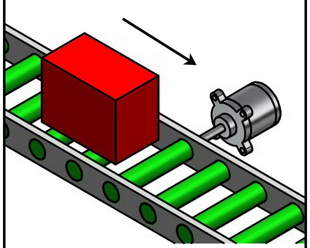
DRIVING TAKE UP REEL



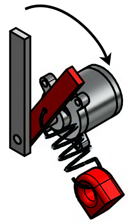
SOLENOID DAMPING



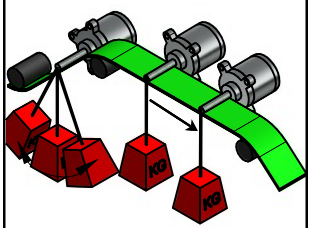
CONVEYOR ROLLER DAMPING



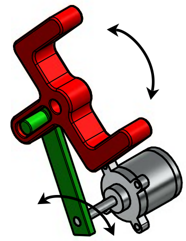
DAMPING SPRING LOADED ARM



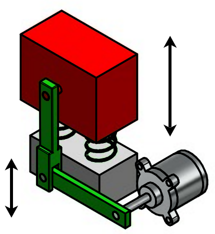
HANGING CONVEYOR DAMPING



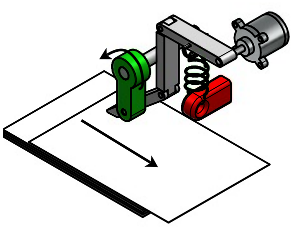
MANUAL CONTROL YOKE DAMPING



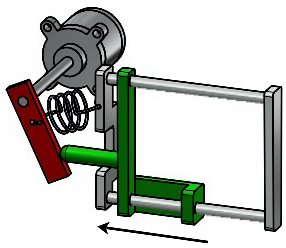
DAMPING ANTI-VIBRATION MOUNTING



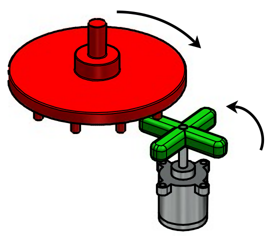
DAMPING HIGH SPEED PAPER FEED



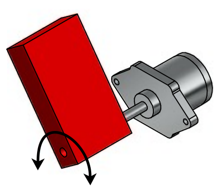
CARRIAGE END STOP DAMPING



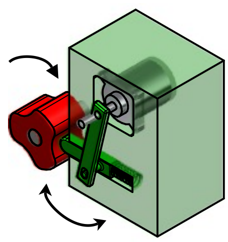
INDEXING TABLE BOUNCE DAMPING



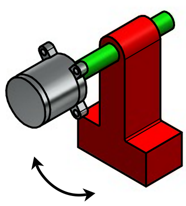
DAMPING UNBALANCED WEIGHTS



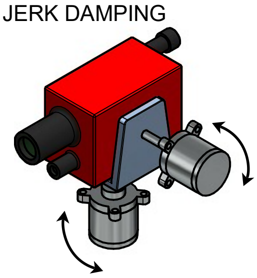
TURNSTILE MOTION CONTROL



PENDULUM SWING DAMPING



CAMERA PAN & TILT JERK DAMPING



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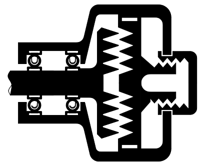
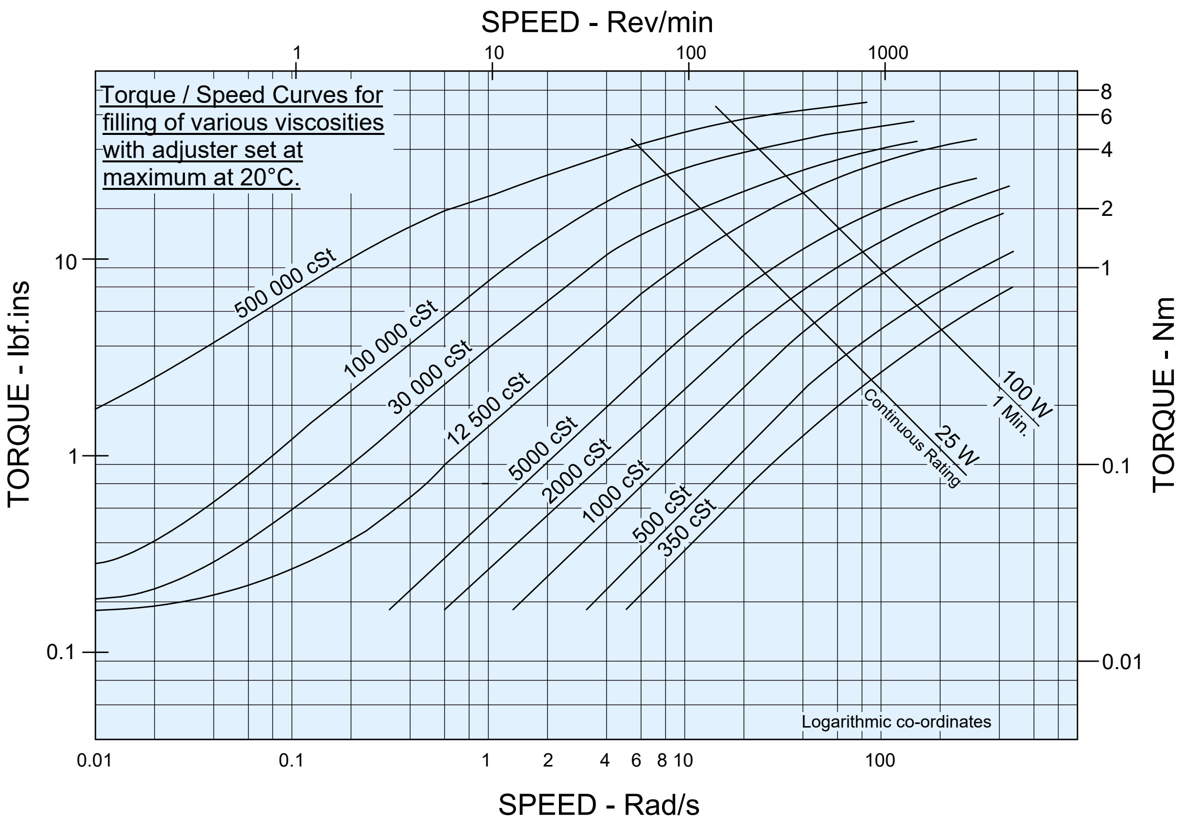
Kinetrol Model S-CRD CR Dashpot



Rates

Adjustable - see curves (± 10%)

Adjustment allows the rate to be varied down to ⅒ of the maximum values, for any speed of rotation.



Viscosities Available

350; 500; 1,000; 2,000; 5,000; 12,500; 30,000; 100,000; 500,000 cSt.

Specification of fluid viscosity provides torque/speed characteristics shown by the curves above.

Ordering Codes

S – CRD – (Filling Viscosity)

Example:

S – CRD – 30,000 has a 30,000 cSt filling.

Kinetrol Model S-CRD CR Dashpot

Specification

Max. safe torque
7 Nm / 61 lbf.ins

Max. shaft end load
89 N / 20 lbf

Max. shaft side load
115 N / 26 lbf

Ambient temperature range
0°C to 60°C (32°F to 140°F)

Frictional torque
0.015 Nm / 0.13 lbf.ins typical

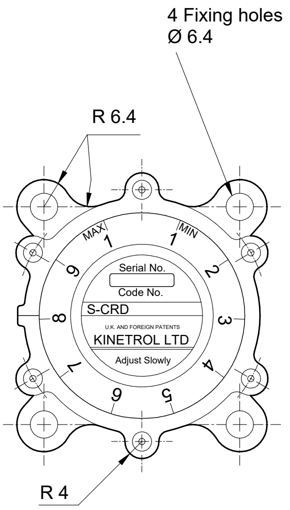
Shaft material
Stainless steel 303S31

Body material
Zinc alloy Mazak 3

Weight
619 g / 1.32 lbs

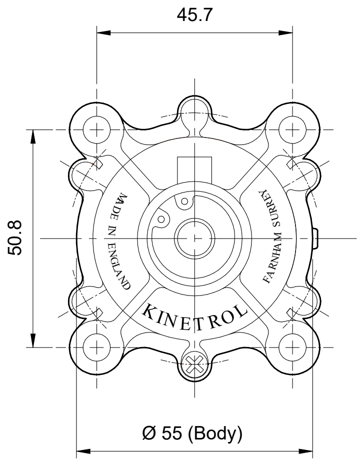
Dimensions

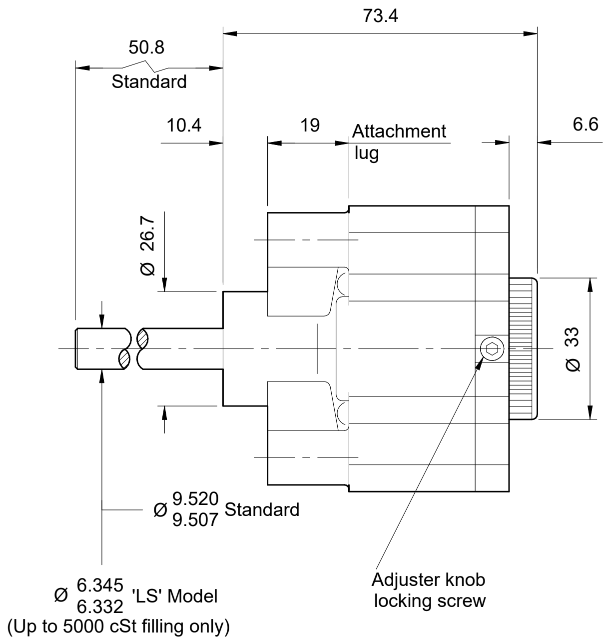
Dimensions in mm.



The adjuster knob, although marked for reference, is not normally calibrated.

Adjuster knob variations available - contact Kinetrol





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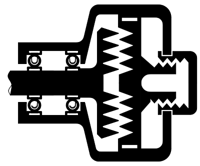
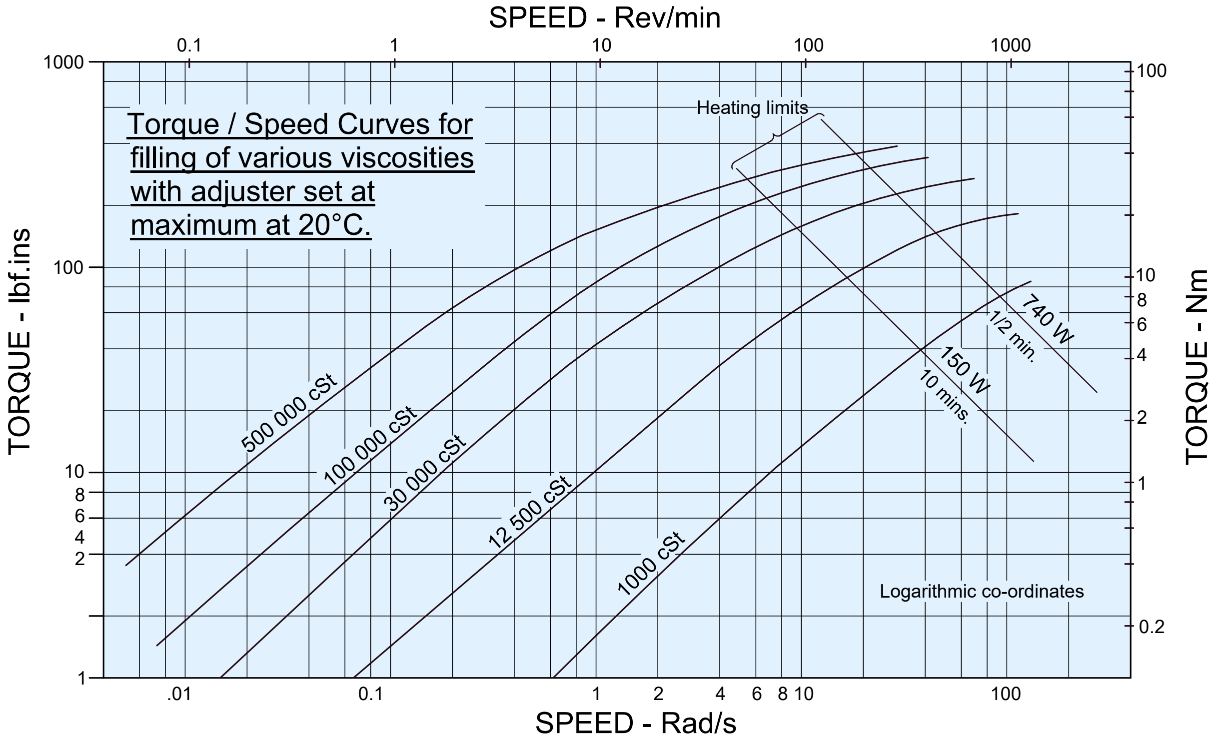
Kinetrol Model T-CRD CR Dashpot



Rates

Adjustable - see curves (± 10%)

Adjustment allows the rate to be varied down to ¼ of the maximum values, for any speed of rotation.



Viscosities Available

1,000; 12,500; 30,000; 100,000; 500,000 cSt.

Specification of fluid viscosity provides torque/speed characteristics shown by the curves above.

Ordering Codes

T – CRD – (Filling Viscosity)

Example:

T – CRD – 100,000 has a 100,000 cSt filling.

Kinetrol Model T-CRD CR Dashpot

Specification

Max. safe torque
45 Nm / 398 lbf.ins

Max. shaft side load
183 N / 41 lbf

Ambient temperature range
0°C to 60°C (32°F to 140°F)

Frictional torque
0.056 Nm / 0.5 lbf.ins typical

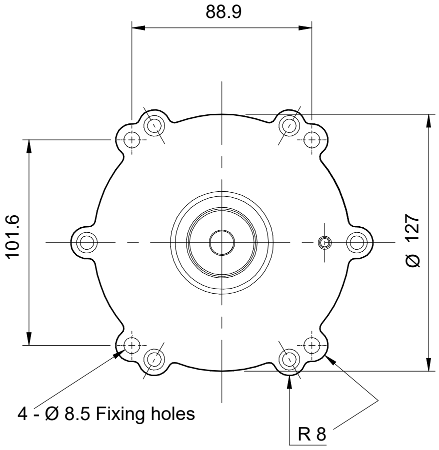
Shaft material
High tensile steel 605M36(T)

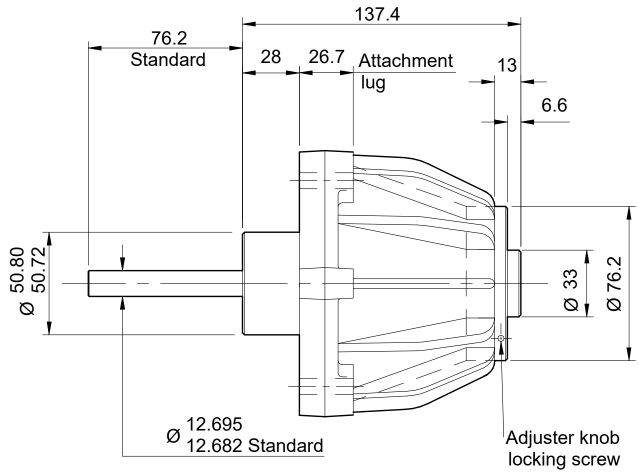
Body material
Cast Aluminium LM 4M

Weight
2.39 kg / 5.27 lbs

Dimensions

Dimensions in mm.

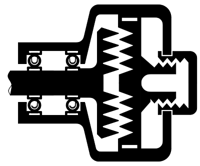


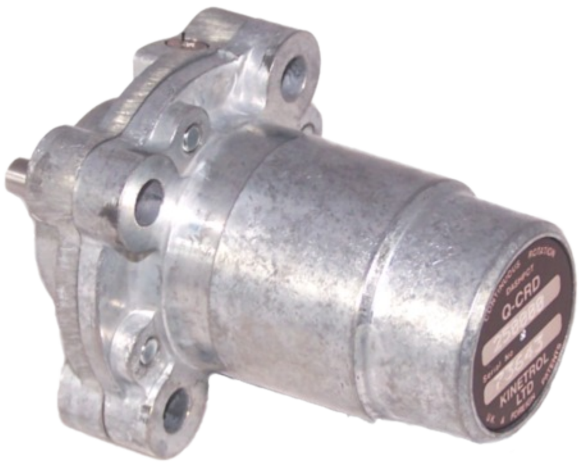


The adjuster knob, although marked for reference, is not normally calibrated.

Fixed rate version available - contact Kinetrol

Kinetrol Model Q-CRD CR Dashpot





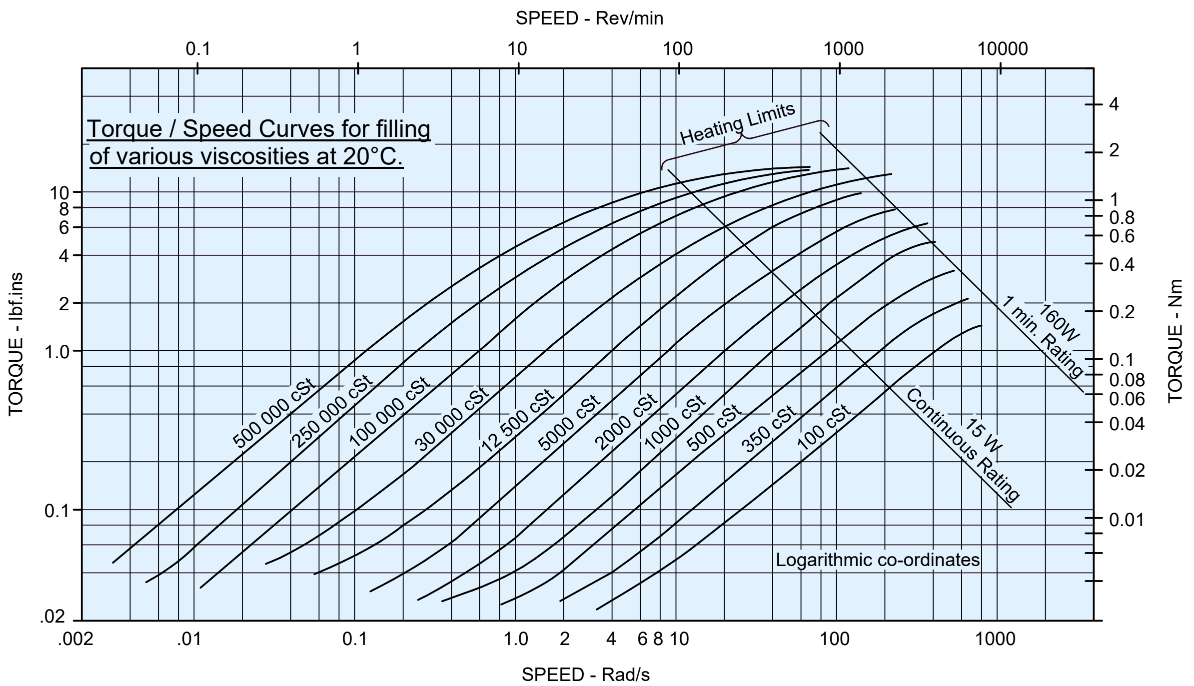
Applications

Proves to be economical where use of the larger adjustable rate models may not be justified.

This dashpot is available with double ended shaft (code suffix –DE). In this version, due to the extra shaft seal, there is greater stiction torque (less than 0.0028 Nm / 0.025 lbf.ins/seal).

Rates

Fixed - see curves (± 10%)



Viscosities Available

100; 350; 500; 1,000; 2,000; 5,000; 12,500; 30,000; 100,000; 250,000; 500,000 cSt.

Specification of fluid viscosity provides torque/speed characteristics shown by the curves above.

Ordering Codes

Q – CRD – (Filling Viscosity)

Example:

Q – CRD – DE – 12,500 is double ended and has a 12,500 cSt filling.

Kinetrol Model Q-CRD CR Dashpot

Specification

Max. safe torque
1.5 Nm / 13 lbf.ins

Max. shaft end load
89 N / 20 lbf

Max. shaft side load
23 N / 5.2 lbf

Ambient temperature range
0°C to 60°C (32°F to 140°F)

Frictional torque
0.003 Nm / 0.025 lbf.ins typical

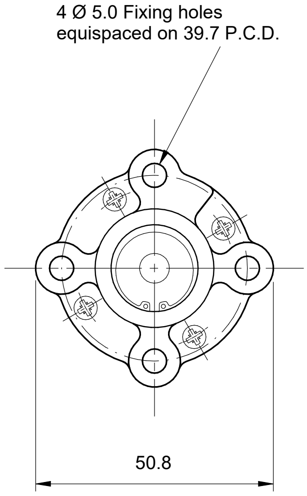
Shaft material
Mild steel 220M07

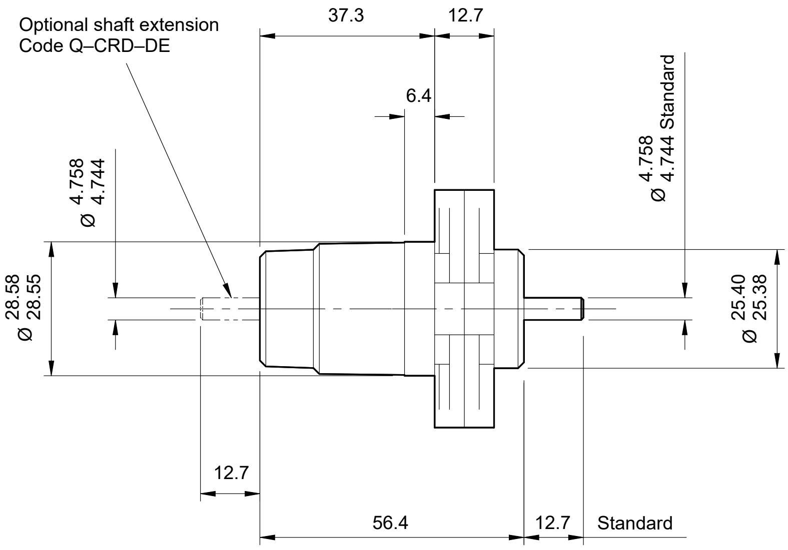
Body material
Zinc alloy Mazak 3

Weight
160 g / 5.6 ozs

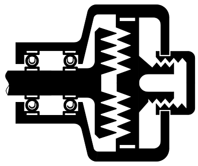
Dimensions

Dimensions in mm.





Kinetrol Model N-CRD CR Dashpot



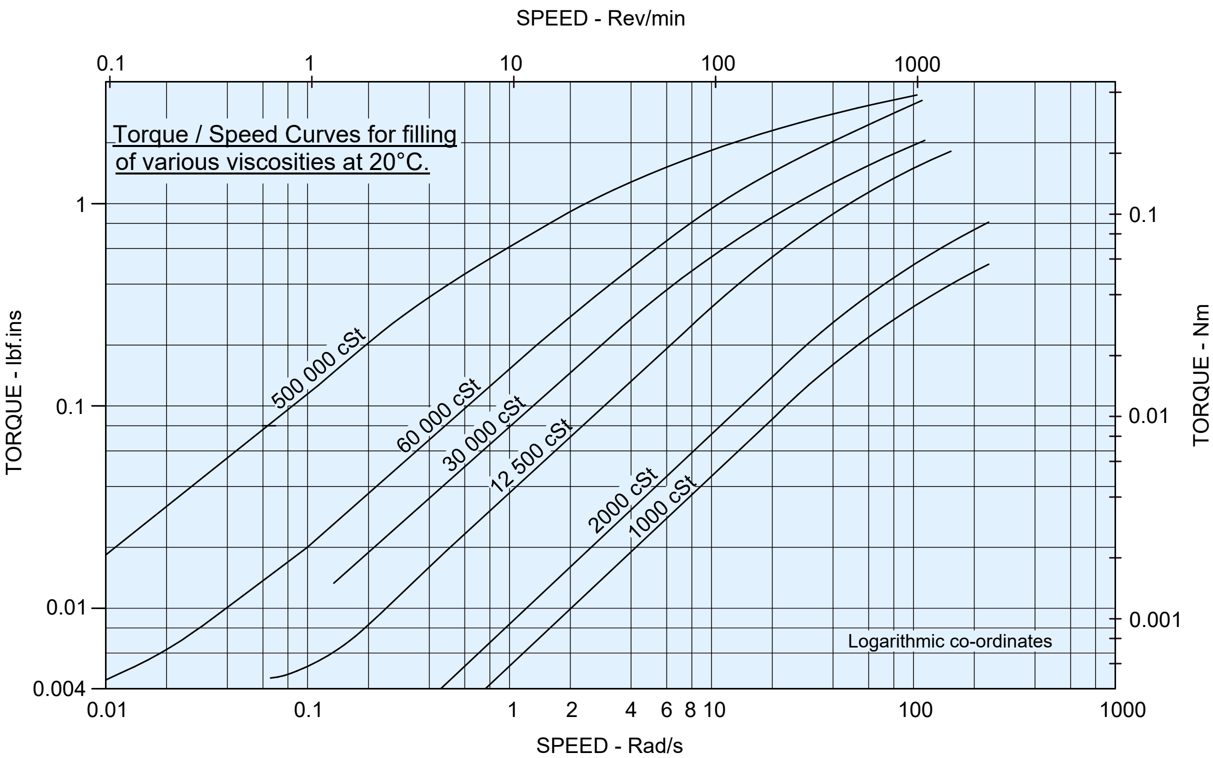
Applications

Particularly suited to instrument and small precision machine applications. Pure viscous damping is produced by shear of a film of silicone fluid. The drum type rotor is supported at both ends by miniature ball races.

Typical applications include tension control, damping moving parts in small precision machines and detection of shaft rotation.

Rates

Fixed - see curves (± 10%)



Viscosities Available

1,000; 2,000; 5,000; 12,500; 30,000; 60,000; 500,000 cSt.

Specification of fluid viscosity provides torque/speed characteristics shown by the curves above.

Ordering Codes

N – CRD – (Filling Viscosity)

Example:

N – CRD – 60,000 has a 60,000 cSt filling.

Kinetrol Model N-CRD CR Dashpot

Specification

Max. safe torque
0.4 Nm / 3.5 lbf.ins

Max. shaft end load
13 N / 3 lbf

Max. shaft side load
10 N / 2.2 lbf

Ambient temperature range
0°C to 60°C (32°F to 140°F)

Low frictional torque
0.002 Nm / 0.015 lbf.ins typical

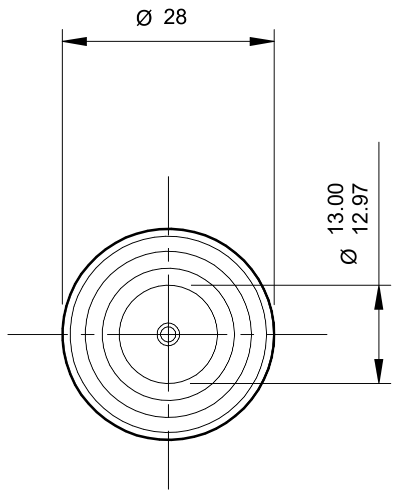
Shaft material
Stainless steel 431S29

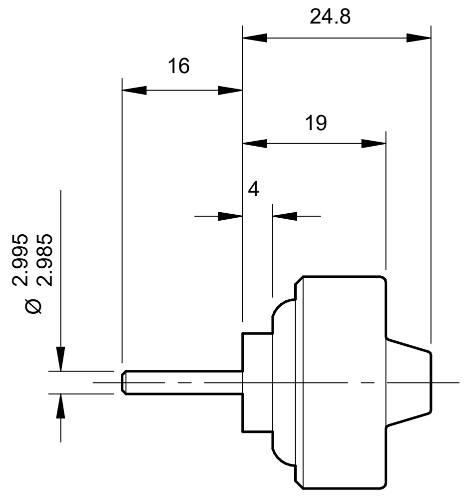
Body material
Zinc alloy Mazak 3

Weight
34 g / 0.075 lbs

Dimensions

Dimensions in mm.





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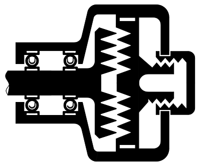
Kinetrol Model X-CRD CR Dashpot



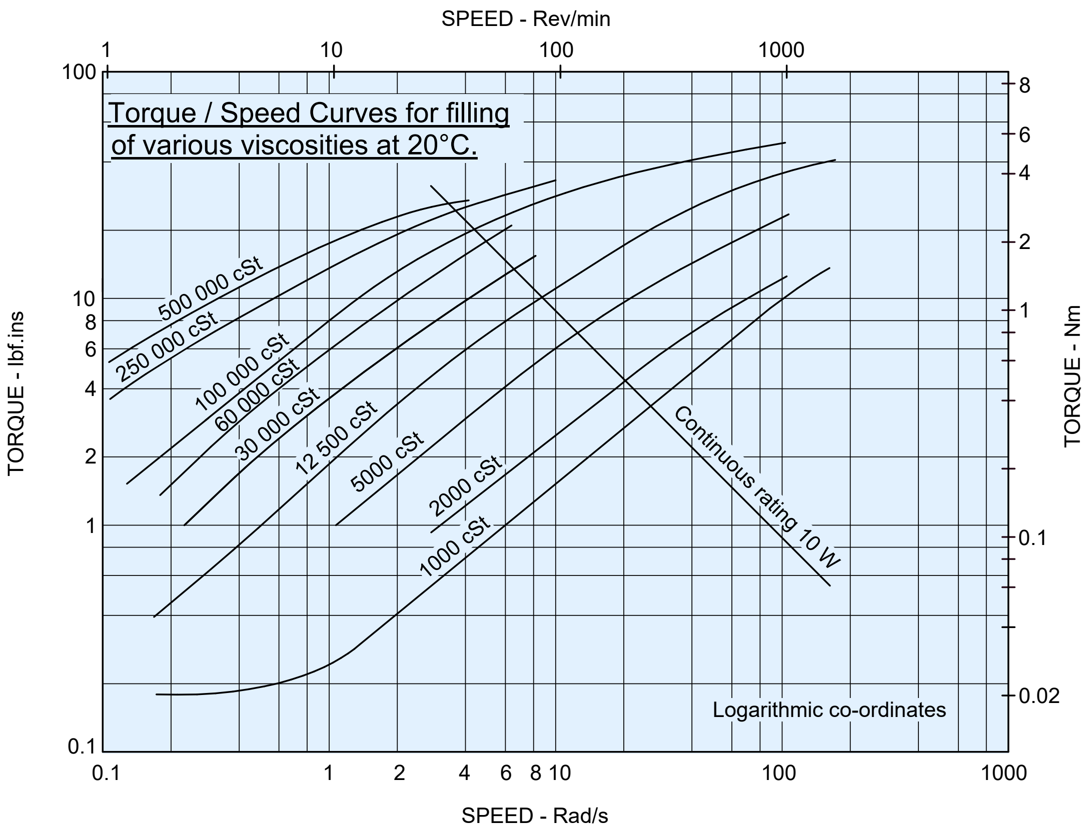
Applications

Value engineered to suit volume applications where unit cost is of paramount importance. Viscous damping is produced by shear of a film of silicone fluid, using a drum type rotor. Static friction is higher than for other dashpots in the range but is not significant for most applications. The dashpot is designed to react pure torsion and therefore side or axial loads should be avoided.

Typical applications include damping moving parts in light machinery, e.g. Copying machines, control of coil dereeling, control of descent.

Rates

Fixed - see curves (± 10%)



Viscosities Available

1,000; 2,000; 5,000; 12,500; 30,000; 60,000; 100,000; 250,000; 500,000 cSt.

Specification of fluid viscosity provides torque/speed characteristics shown by the curves above.

Ordering Codes

X – CRD – (Filling Viscosity)

Example:
X – CRD – 12,500 has a 12,500 cSt filling.

Kinetrol Model X-CRD CR Dashpot

Specification

Max. safe torque
6 Nm / 53 lbf.ins

Ambient temperature range
0°C to 60°C (32°F to 140°F)

Frictional torque
0.034 Nm / 0.3 lbf.ins typical

Weight
355 g / 0.78 lbs

Shaft material
Mild steel 080A15 (case hardened). The shaft can be supplied unhardened.

Body material
Zinc alloy Mazak 3

Bearing
Single overhung anti-friction bush

Dimensions

Dimensions in mm.