MELDRO® Hy-Thrust™ 3 Phase Electro-Hydraulic Actuators

General Information

MELDRO® Hy-Thrust Actuators are electro-hydraulic devices which combine all the basic elements of a hydraulic system into one integral unit, consisting of: electric driving motor, hydraulic pump, piping, working cylinder and piston. The function of the actuator is to convert electrical energy hydraulically into a mechanical force to produce a smooth positive straight-line thrust throughout a given piston stroke.

APPLICATIONS

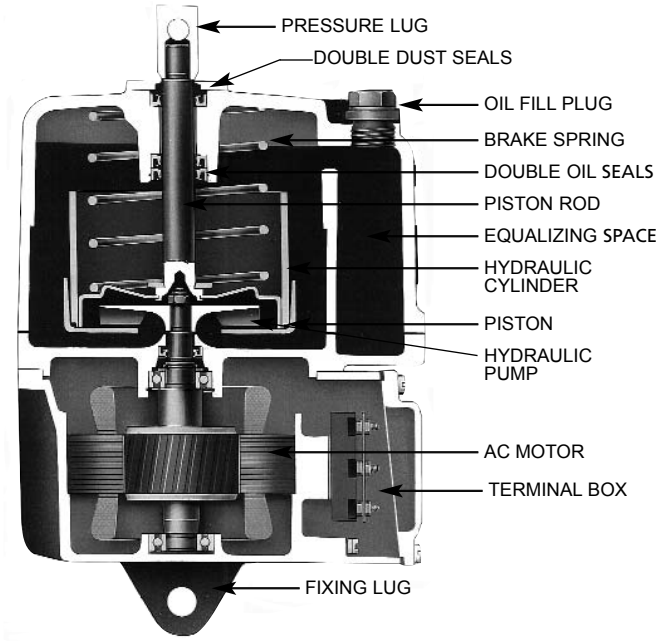
The electro-hydraulic actuator was first introduced in the 1930's. Since then, the design and performance has been continuously improved and refined. The latest state-of-the-art MELDRO® Hy-Thrust Actuators are the culmination of these developments. MELDRO® Hy-Thrust Actuators can be applied wherever a straight line force is required, or, when this can be modified by some mechanical arrangement, such as a bell crank lever. This type of actuator was used originally to operate band and disc brakes. However, with the dramatic increase in mechanization and automation, a much wider market has evolved, and the following are some of the application possibilities: valves, slides, flaps, clutches, latching and locking devices, unloading equipment, overhead chain and trolley conveyors, power presses, punching machines, shears, and switching controls for railways. Being electrically controlled and completely self-contained, the MELDRO® Hy-Thrust units are advantageous when compared to full scale piped hydraulic/pneumatic systems for remote locations where a single or a small number of actuators are required.

OPERATION AND CONSTRUCTION

The major components of the Hy-Thrust Actuator are the electric motor, centrifugal pump and servo-cylinder with piston, all of which are mounted on an axis. Hydraulic fluid provides the operating medium and all units are provided filled with the correct fluid for the application.

With the motor "switched-off", the piston rests at the bottom of its stroke. When the motor is "switched-on", the working fluid is displaced by the vanes of the impeller and forced against the underside of the piston. As a result of the pressure produced, the piston rod extends, thus compressing the built-in spring (C spring) or operating against the external spring or load. At the limit of piston travel, the power taken by the motor reduces to approximately half that required during the piston travel. This is due to the design characteristics of the motor/pump. Also, at this point, the fluid pressure reaches its highest value, which is approximately 30% above the rated value. When the motor is "switched-off" the piston rod returns to the bottom of its stroke due to the force exerted by the return springs or external load.

The MELDRO® Hy-Thrust Actuators are fitted with 3 phase squirrel cage induction motors which do not require overload protection. The impeller runs freely inside the cylinder and even if the piston rod does not complete its full stroke, the motor is not subject to an overload condition. The impeller is designed with radial vanes so the direction of rotation of the motor/impeller has no effect on the operation, or performance of the actuator.



MECHANICAL DESIGN

ENCLOSURE

The standard enclosure is cast in aluminum alloy and fitted with double shaft seals, as a minimum, which makes the units weatherproof and dustproof to IP65 standards. Nevertheless, for prolonged exposure to rain and snow, a separate cover is recommended. The standard units are not recommended for operation in heavily corrosive environments such as chemical or marine applications, or, where thick sticky dust is present. Special enclosures and paint finishes are available for these kinds of applications and details should be included with the inquiry.

MOUNTING POSITIONS

Vertical—Thrust rod at top.

Horizontal and intermediate—Equalizing space "Z" must always be uppermost. As shown in Fig. 1–page 4 .

WORKING FLUID

Standard actuators are provided filled with Shell Tellus C10 which is suitable for operation in ambient temperature range -13°F (-25°C) through +122°F (+50°C).

To operate outside of this range, special fluids are available, also built-in heaters for extremely low temperature operation.

PISTON ROD SEALING

Types Ed23/5–Ed 80/6:

Double sealing	Standard
Fourfold sealing	Optional

Types Ed 121/6–Ed301/12

Double dust seal	Standard
Double hydraulic seal	Standard
Piston rod seal	Standard

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General Information

OPTIONAL FEATURES

EXTEND AND RETRACT TIME DELAYS (H, S, HS)

Built-in extending (H) and/or retracting (S) time delay valves can be fitted. The time delays are stepless and can be adjusted externally even when the unit is in operation.

Approximate Operating Times and Time Delays (Seconds) at 68°F (20°C) Working Oil Temperature

Catalog #	Time to Extend		Time to Retract	
	Without Valve	With Valve	Without Valve	With Valve
Ed 23/5	0.4	0.7– 6.0	0.4	0.6– 6.0
Ed 30/5	0.4	0.5– 8.0	0.4	0.5– 8.0
Ed 50/6	0.5	0.7– 10.0	0.4	0.5– 8.0
Ed 80/6	0.4	0.5– 8.0	0.4	0.4– 8.0
Ed 121/6	0.4	0.5– 8.0	0.5	0.5– 10.0
Ed 201/6	0.5	0.7– 10.0	0.4	0.4– 8.0
Ed 301/6	0.6	0.7– 12.0	0.4	0.4– 8.0
Ed 50/12	0.8	1.0– 16.0	0.6	0.7– 12.0
Ed 80/12	0.6	0.9– 12.0	0.5	0.6– 10.0
Ed 121/12	0.8	1.0– 16.0	0.7	0.8– 14.0
Ed 201/12	1.0	1.3– 20.0	0.5	0.6– 10.0
Ed 301/12	1.1	1.6– 22.0	0.5	0.9– 10.0

BRAKE SPRING (C SPRING)

The built-in compression spring serves as a braking spring and generates the torque when fitted to the brake movement. The specified "C" spring force is valid for 1/3 of the piston rods rated extend stroke, or 2/3 of the retract stroke.

TROPICAL AND CORROSION PROTECTION

For corrosive atmospheres and/or extremely damp and humid conditions the following are available:

MOTOR	Stator completely encapsulated in motor housing under vacuum.
PAINT	Polyurethane lacquer. Priming–1 coat, zinc chromate. Finish–2 coats, polyurethane varnish.

LIMIT SWITCHES

A number of mechanical and magnetic proximity switches are available for indication, interlock and warning functions.

BASE ADAPTORS

The standard stock units are fitted with a fixed lug. Detachable baseplates and flange adapters are available on special order.

ELECTRICAL DESIGN (CSA APPROVED)

MOTOR

- 2 Pole, 3 phase AC squirrel cage motor.
- Totally enclosed to IP65 standards.
- Insulation–Class F, (normal operation of the motor is within Class B Temperature rise).

RATINGS

- Continuous operation.
- Intermittent operation—refer to ratings table.

VOLTAGE – FREQUENCY

- Standard stock–230V, 460V, 575V/3 Ph/60Hz.
- Special voltages and frequencies available on special order.
- DC and 1 Phase not available.

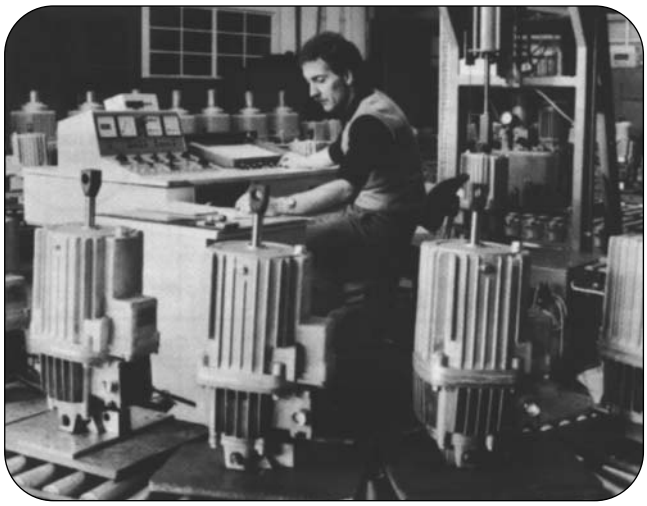
Motor Operating Currents (60Hz)

	230 Volt/60Hz	460 Volt 60Hz	575 Volt 60Hz
Ed 23	0.95 Amps	0.44 Amps	0.38 Amps
Ed 30	0.80	0.38	0.33
Ed 50	0.90	0.43	0.37
Ed 80	2.4	1.1	0.96
Ed 121	2.4	1.1	0.96
Ed 201	2.6	1.2	1.2
Ed 301	2.8	1.3	1.1
Ed 185	2.6	1.2	1.0

- Currents above are for 68°F (+20°C) Oil Temperature.
- Starting currents are approximately 6–8 times operating currents.

TERMINAL BOX

- Totally enclosed to Nema 4 Standards.
- Terminal block—6 Pole for Star/Delta connection.



MELDRO® HY-THRUST TESTING

MELDRO® Hy-Thrust™ 3 Phase Electro-Hydraulic Actuators

General Information

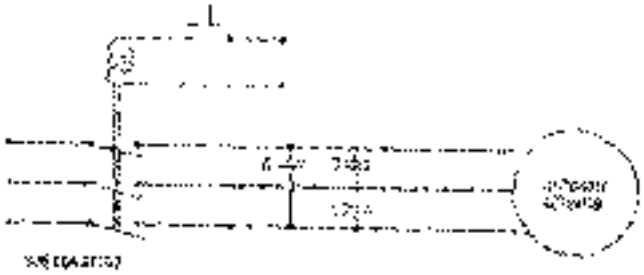
MOTOR CONNECTIONS

Since the operation of the MELDRO® Hy-Thrust Actuator is not dependent on the direction of motor rotation, the cable leads can be connected in any sequence to the U1, V1 and W1 terminals. Motors normally leave the works star-connected.

The motor must be connected to the supply by means of a flexible cable or conduit.

FAST-RETRACT FUNCTION

The normal retracting times can be reduced to approximately 85% of those given in the ratings table by connecting three capacitors in parallel with the stator winding which reduces the deceleration time of the motor. In this case, the actuator must be energized via a 3-phase contactor as shown on the schematic diagram.



MAINTENANCE

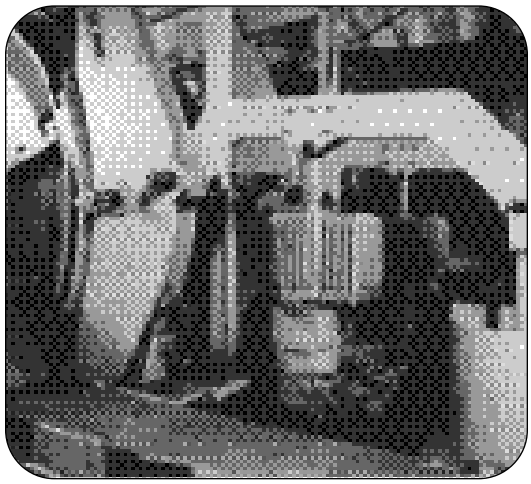
MELDRO® Hy-Thrust Actuators require minimal maintenance.

LIFE

Under normal operating conditions, Hy-Thrust Actuators have a minimum working life of 20 million switching cycles. This corresponds to approximately 100,000 operating hours.

HAZARDOUS LOCATIONS

Explosionproof and flameproof designs are available certified for use in a number of envrionments. Please check with factory for details.



MELDRO® TYPE EdF–FLAMEPROOF HY-THRUST ACTUATOR FITTED TO HOIST BRAKES IN UNDERGROUND COAL MINE.

Capacitors for Fast Retract

Size	Voltage	Capacitance/Phase
Ed 23/30	230 V	25 µF
	460 V	6
	575 V	4
Ed 50/80/121/201/301	230 V	60
	460 V	16
	575 V	10

ORDERING CODE:

Example:	Ed 30/5c, d, H, S, E
Ed	MELDRO®, 3 Ph., AC Version
30	Lifting Force (Kg)
5	Stroke (cm)
c	Brake Spring (c-spring)
d	Damping Spring (d-spring)
H	Lifting Valve
S	Lowering Valve
E	Limit Switch, Mechanical
EB	Limit Switch, Magnetic
EdF	Flameproof
EdE	Explosionproof

Hi-Tork™ Brake Range

Dimensions and Ratings

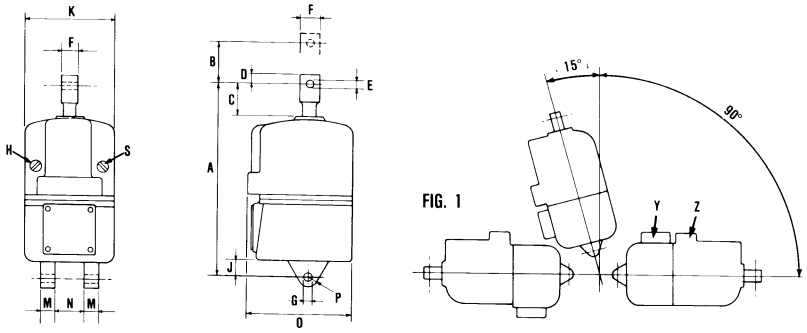


FIG. 1

MOUNTING POSITIONS FOR MELDRO® THRUSTERS

Approximate Dimensions (Inches)

Type	A	B	C	D	E	F	G	J	K	M	N	O	P
Ed 23/5	11 1/4	2	1	7/16	5/8	3/4	5/8	3/4	6 5/16	3/4	1 9/16	7 7/8	5/8
Ed 30/5	14 9/16	2	1 3/8	9/16	5/8	5/8	5/8	3/4	6 5/16	3/4	1 9/16	7 3/4	5/8
Ed 50/6	17 1/8	2 3/8	1 7/16	5/8	3/4	7/8	7/8	7/8	6 5/16	1 3/16	2 3/8	10 3/4	7/8
Ed 80/6	17 3/4	2 3/8	1 7/16	5/8	3/4	7/8	7/8	7/8	6 5/16	1 3/16	2 3/8	10 3/4	7/8
Ed 50/12	20 1/4	4 3/4	1 7/16	5/8	3/4	7/8	7/8	7/8	6 5/16	1 3/16	2 3/8	10 3/4	7/8
Ed 80/12	20 1/8	4 3/4	1 7/16	5/8	3/4	7/8	7/8	7/8	6 5/16	1	2 3/8	10 3/4	7/8
Ed 121/6	25 3/8	2 3/8	1 1/2	1	1	1	1	1	9 7/16	1	1 9/16	10 1/4	1
Ed 201/6	25 3/8	2 3/8	1 1/2	1	1	1	1	1	9 7/16	1	1 9/16	10 1/4	1
Ed 301/6	25 3/8	2 3/8	1 1/2	1	1	1	1	1	9 7/16	1	1 9/16	10 1/4	1
Ed 121/12	27 3/4	4 3/4	1 1/2	1	1	1	1	1	9 7/16	1	1 9/16	10 1/4	1
Ed 201/12	27 3/4	4 3/4	1 1/2	9/16	1	1	1	1	9 7/16	1	1 9/16	10 1/4	1
Ed 301/12	27 3/4	4 3/4	1 1/2	1	1	1	1	1	9 7/16	1	1 9/16	10 1/4	1
Ed 185/16	27 9/16	6 1/8	1 2/3	1	1	1 1/16	1 1/16	1 23/32	9 7/16	1 23/32	3 5/32	10 1/4	1

For construction purposes request certified drawing.

Rating Data and Approximate Weights

Fitted with Moulded Non-Asbestos Linings

Catalog #	Extending Thrust		Stroke		Return Force C-Spring		Power Input (2) (Watts)	Switching Frequency (1) (OPH)	Net Weight (LB.)
	(LB.)	(N.)	(INCH)	(MM)	(LB.)	(N.)			
Ed 23/5	50	220	2	50	40	180	140	2000	22
Ed 30/5	65	300	2	50	60	270	175	2000	31
Ed 50/6	110	500	2 3/8	60	100	460	190	2000	51
Ed 80/6	175	800	2 3/8	60	165	750	260	2000	53
Ed 121/6	275	1250	2 3/8	60	265	1200	450	2000	86
Ed 201/6	440	2000	2 3/8	60	420	1900	800	2000	86
Ed 301/6	660	3000	2 3/8	60	615	2800	1100	2000	88
Ed 50/12	110	500	4 3/4	120	—	—	190	1200	58
Ed 80/12	175	800	4 3/4	120	—	—	260	1200	60
Ed 121/12	275	1250	4 3/4	120	—	—	450	1200	86
Ed 201/12	440	2000	4 3/4	120	—	—	500	1200	86
Ed 301/12	660	3000	4 3/4	120	—	—	1100	1200	88
Ed 185/16	405	1850	6 1/8	155	—	—	450	400	88
Explosionproof Types									
EdE 30/5	65	300	2	50	60	270	175	2000	60
EdE 50/6	110	500	2 3/8	60	100	460	190	1500	80
EdE 80/6	175	800	2 3/8	60	165	750	260	1500	82
EdE 50/12	110	500	4 3/4	120	—	—	190	900	86
EdE 80/12	175	800	4 3/4	120	—	—	260	900	88

(1) Frequency of switching can be increased at rated load if the total stroke is not used or the motor is always switched in same direction of rotation.
(2) Values at +20°C Oil Temperature.

Hi-Tork™ Brake Range

Selection and Application Data

When selecting a brake, consideration must be given to the design characteristics and features of the various types of brakes available, the torque and/or energy requirements of the load and any special engineering or environmental conditions imposed by the application. The 200S and 300M range of industrial purpose shoe brakes is suitable for a wide range of industrial, mining, mechanical handling equipment, and most types of rotating machinery applications.

The ratings, features and dimensions for each type of brake are given in the technial bulletin and the following summary covers the major points which should be considered before selecting the type of brake for a particular application.

DC BRAKES

DC magnet operated brakes are fitted with short stroke clapper type actuators which are quiet in operation and relatively quick acting. The rugged construction requires a minimum number of parts and the simple design has proved to be extremely reliable, even for the most arduous applications. The totally encapsulated coils are sealed into the actuator housing which protects the coil from water, oil and dust. The coil and gasketed terminal box are virtually waterproof. DC brakes can be supplied with shunt or series wound coils for most standard voltages and ratings. It is important to establish which type of coil design is required before proceeding to the brake size selection procedure.

SHUNT BRAKES

Shunt wound brakes can be continuous or one hour rated and designed to release the brake at 80% or less of the rated voltage and give satisfactory performance at 110% of rated voltage. The brake coils can be designed for operation on supplies from 12V to 500V DC.

All DC brakes have high inductance which results in the comparatively slow build-up and decay of the magnetic flux. This makes the response times of DC shunt wound brakes slightly longer than the AC solenoid operated brakes. If the application requires faster response, some method of field forcing must be used. ***Note:*** Series wound brakes have fast response times and may be an alternative to the “forced” shunt brake on certain applications.

The setting time of DC brakes can be increased to approximately one second by using a thicker armature or fitting a reverse connected diode across the coil. This feature is sometimes used to achieve discrimination between the service and emergency brakes on dual brake drives.

SERIES BRAKES

Series wound brakes are usually half hour or one hour rated and designed to release the brake at 40% or less of rated motor current, and to allow the brake to set at 10% of the rated motor current.

Series wound brakes designed to AISE specifications are rated to match the torque and current ratings of a specific mill motor frame. This is not always the case with industrial series motors and it is important to obtain full details of the motor and application in order to establish the correct brake coil design.

TYPICAL APPLICATIONS:

Crane Hoist, Bridge & Trolleys, Gate Hoists, Ore Bridges, Coiling Machines, and Ski-Lifts.

AC BRAKES

MELDRO® Hy-Thrust™ Actuators are only available with squirrel cage motors suitable for operation on a 3 phase, 50-60 Hz supply. Standard stock actuators include 230V/460V/600V – 3 Phase – 60 Hz supplies – other voltages and frequencies are available.

Hy-Thrust™ actuators are completely sealed, quiet in operation and have a smooth quick action. The motor **cannot be overloaded** even if the thrust rod is prevented from reaching its full stroke. (This is an important feature when compared with the inevitable downtime and replacement costs of AC solenoid brake coils).

The actuators are rated for continuous operation and have a maximum switching frequency of between 400-2000 operations/hour, depending on the actuator size, stroke and the ambient temperature.

Optional features include stepless, externally adjustable time delays on the lifting and/or lowering directions. This feature can be useful on crane bridge motions, uphill and downhill conveyor brakes, and scoop couplings. It also provides a simple method of discrimination between two brakes on dual brake applications.

TYPICAL APPLICATIONS:

Crane Hoist, Bridge & Trolley Motions, Gantry Cranes, Shiploaders, Ore Bridges, Winches, Deck Machinery, Conveyors, Stacker/Reclaimers, and Cable Reels.

EXPLOSIONPROOF

MELDRO® Actuators are also available in explosionproof and flameproof enclosures certified to several international standards.

PEDAL OPERATED HYDRAULIC BRAKE AND HYDRAULIC/ELECTRIC SYSTEMS

The pedal operated hydraulic braking system used with the hydraulic brakes provides the operator with a controlled variable pressure/torque braking system which functions like the brakes on an automobile. The brakes can be arranged to apply or release depending on the application requirements. Various options included: remote electric bleeding, change-over valves for operation from two stations, lock-on valves to seal the system for parking, pressure switches, handwheels for mechanical parking, and electrical interlock switches.

Hydraulic over-ride—The same basic system and components used on the hydraulic brakes can be utilized to provide a hydraulic over-ride system for the types SA, ST, ST/E, BE, BT, and BT/E brakes.

TYPICAL APPLICATIONS:

Cab and Dual Controlled Bridge Motions, E.O.T. Cranes, Gantry Cranes, and Hatch Cover Cranes.

Hi-Tork™ Brake Range

Selection and Application Data

POWERED HYDRAULIC & PNEUMATIC BRAKES

The type SM/E and SP/E Brakes are normally spring-applied and powered to release. They are designed to operate on powered hydraulic or pneumatic system with a typical operating pressure of 80–100 PSI.

TYPICAL APPLICATIONS:

Emergency Brakes on Machine Tools, Rubber Mills, Coiling Machines, and on all drives located in explosionproof environments (i.e. Grain Elevators).

MECHANICAL BRAKES

The type SM/L is a simple lever operated mechanical brake. The torque is determined by the amount of weight suspended at the end of the lever.

TYPICAL APPLICATIONS:

- Drag Brakes on Crane Trolleys.
- The type S/W is operated from a screw-down handwheel, the torque being controlled by the amount of pressure applied by the handwheel. These brakes can be fitted with various options such as electrical interlock switches, and padlocks.

TYPICAL APPLICATIONS:

Locking Brake on Ventilation Fans, Gate Hoists & Large Machines, and Parking Brakes on Gantry Cranes.

BRAKE WHEELS

The standard Mondel brake wheels are manufactured from Ductile Iron and are available with symmetrical or offset hubs. They can be supplied with a solid hub, rough bored or finished bore and keyway to customers' specifications. When selecting a brake wheel, always check the selection against the maximum allowable rotational speeds for standard wheels as shown on page-8.

Non-standard sizes, materials, balancing, heat-treating and carburizing can all be supplied on special order.

BRAKE WHEEL COUPLINGS

Gear type and flexible brake wheel couplings are available for installation where the space between the driving motor and reducer is limited. They also eliminate the need for expensive double shaft extensions on motor and gear units.

BRAKE LOCATION

Whenever practical, a brake should always be positioned on the high speed shaft of the power transmission system. In most cases, this will be on the electric motor shaft which ensures that a brake with the lowest possible torque is selected.

Note: Mondel's Hydraulic/Electric Brakes are usually compatible with existing hydraulic systems. Consult factory to determine compatibility.

ELECTRICAL CONSIDERATIONS

Mondel electric brakes are available for all standard voltages, ratings and classes of insulation. Details of specific actuators are listed in the technical manual.

Class F insulation is standard on both the AC and DC actuators. Class H insulation is used when required for extreme operating conditions. ***Note:*** The maximum permissible sustained temperature rise for some types of flameproof Hy-Thrust™ Actuators is 266°F (130°C). These units may be supplied with Class B insulation.

The maximum coil temperature limits established by UL standards for a maximum ambient temperature of 104°F (40°C) are as follows:

Class F Insulation – 311°F (155°C)
Class H Insulation – 356°F (180°C)

If the ambient temperature is above 104°F (40°C) and/or the duty cycle exceeds the maximum recommendation for the equipment, details of the application should be submitted to the plant for evaluation.

All the electric brakes listed in the technical manual are of the spring-set/power-release design. Certain types and sizes can be supplied power set/spring-release.

All the electric brakes listed in the technical manual are certified by the Canadian Standards Association.

ENVIRONMENTAL CONSIDERATIONS

The standard Mondel brakes are suitable for operation indoors or in a protected outdoor location. The mechanical parts are painted, plated or non-corrosive – stainless steel pivot pins fitted with lubricators, and can be supplied for very arduous applications. AC and DC actuators are either encapsulated or gasketed which makes them impervious to moisture and dust.

Magnetic dust is attracted to DC actuators and collects between the armature and actuator. To prevent accumulation a bellows type dust seal can be fitted around the actuator/armature air gap.

Waterproof and dust tight enclosures are available for most brake types. These enclosures are normally required for outdoor installation, or in wet, dusty or abrasive atmospheres. Anti-condensation heaters can be fitted for operation in low-temperature applications. ***Note:*** MELDRO® Actuators can be supplied with special fluids and built-in heaters for low temperature operation.

Additional care must be taken when selecting brakes for the following environmental conditions:

1. Airborne magnetic particles.
2. Ambient temperatures above 40°C or below 0°C.
3. Heavy shock and vibration.
4. Airborne salt, oil, corrosives, abrasives or water.
5. Exposure to radiation.
6. Explosive atmospheres–gases or dust.
7. Any other abnormal or unusual conditions.

Hi-Tork™ Brake Range

Selection and Application Data

GENERAL FRICTION LAW

The coefficient of friction between two surfaces in contact is equal to the force required to overcome the friction divided by the reaction force between the two surfaces as shown in the following formula:

$$\mu = \frac{F}{R}$$

Where μ = Coefficient of Friction
F = Force required to overcome the Friction
R = Reaction force between the two surfaces

Therefore, the retarding torque of shoe brakes is a product of the effect of the torque spring pressure and the coefficient of friction of the lining material.

BRAKING TORQUE

- Brake torque is the force applied at the brakewheel to stop the motion of the moving equipment.
- Assuming the operating conditions for the equipment are constant, a brake having a retarding torque equal to the full load torque of the motor to which it is applied is usually satisfactory.

The torque can be determined from the following formula for both AC and DC motors:

$$T = \frac{5250 \times HP \times SF}{RPM}$$

Where:

T = Brake Torque (Lb.Ft.)
5250 = Constant
HP = Motor Horse Power
RPM = Speed of Brakewheel
SF = Application Service Factor

It is assumed that the brake will work on a brakewheel mounted on the motor shaft.

- Depending upon the type of application, the brake torque selected may be greater or less than the full load motor torque. CMAA, OSHA and AISE standards provide guidelines for the application of brakes to hoist, and bridge and trolley drives.

Bridge and Trolley:

Application "SF" for Braking Torque

Application	Bridge		Trolley	
	AISE	CMAA	AISE	CMAA
Cab operated Crane with cab located on the Bridge	–	100%	50%	50%
Cab operated Crane with cab located on the Trolley	100%	75%	–	100%
Floor, Remote and Pulpit-operated Cranes	100%	50%	50%	50%

Hoist Brakes:

Application "SF" for Braking Torque

Standard	Basis for Selection of Brake Torque	Hoist Drive with Single Brake	
		With Control Braking (1)	With Mechanical Load Brake
CMAA	Motor Full Load Torque	125%	100%
OSHA	Torque Required to Hoist Related Load	125%	100%
AISE		150%	150%

Standard	Basis for Selection of Brake Torque	Hoist Drive with Two Brakes (2)	
		Handling Hot Metal	Not Handling Hot Metal
CMAA	Motor Full Load Torque	100%	100%
OSHA	Torque Required to Hoist Related Load	100%	100%
AISE		125%	100%

1) Control Braking is eddy current, counter torque or dynamic lowering brake.
2) Service factor is for each brake.

Using full load motor torque as a guide does not satisfy all applications. The additional energy created by excessive brake operations or duty cycles must also be considered.

EXAMPLE: Find the brake torque and size required for a crane hoist drive fitted with a 35 HP/1800 RPM motor and control braking to CMAA standards.

The brake torque required is:

$$T = \frac{35 \times 5250}{1800} \times \frac{125}{100} = 128 \text{ Lb.Ft.}$$

A type 8" WSA DC brake (or a type 8" WST-Ed 23/5C AC brake) can be selected with the brakewheel mounted on the motor shaft.

In some applications the braking torque may be determined by extreme operating conditions, such as high-inertia loads, overhauling loads, excessive duty cycles, or where stopping time or distance have been specified.

- For high inertia applications or loads where a stop in a specified time or distance is involved, the average brake torque required to retard the total inertia can be determined from the following formula:

$$T_A = \frac{WK2 \times RPM}{308 \times t}$$

Where:

T_A = Brake Torque (Lb.Ft.)
WK^2 = Total inertia referred to Brake Wheel (Lb.Ft.^{2})
RPM = Speed of Brakewheel
308 = Constant
t = Stopping Time (Seconds)

Hi-Tork™ Brake Range

Selection and Application Data

EXAMPLE: Find the average torque required to completely stop an inertia load of 25 Lb.Ft.2 in 2 seconds if the rotational speed is 1800 RPM.

Brake Torque required is:

$$T_A = \frac{25 \times 1800}{308 \times 2} = 73 \text{ Lb. Ft.}$$

- For applications where there is a descending load, the load driveback torque to overcome the overhauling load is determined by the following formula:

$$T_B = \frac{W \times V}{2 \times TT \times RPM} .$$

Where:

T_B = Overhauling Torque (Lb.Ft.)
W = Weight of Load (Lb.)
V = Linear Velocity of descending load (Ft./Min.)
2TT = Constant
RPM = Speed of Brakewheel

Brakewheel speed (RPM) may be greater than the motor speed (overspeeding due to the gravity overhauling load) or may be reduced by electrically controlled dynamic braking.

EXAMPLE: Determine the overhauling torque when lowering a load of 10,000 Lb. at 20 Ft.Min and brakewheel speed of 1800 RPM.

The overhauling torque is:

$$T_B = \frac{10{,}000 \times 20}{2 \times TT \times 1800} = 17.69 \text{ Lb.Ft.}$$

- The total brake torque required to decelerate a descending load and to overcome the overhauling effect is the sum of the calculated torques above:

$$T_T = T_A + T_B$$

Where:

T_T = Total Brake Torque (Lb. Ft.)

During the stopping cycle a brake converts kinetic energy into thermal energy, or heat. This heat is absorbed almost entirely by the brake wheel alone. The brake must be large enough to absorb and dissipate the heat generated (thermal capacity) without exceeding the temperature limitations of the linings and brakewheel.

There are two categories of thermal capacity for a brake. The first is the maximum kinetic energy the brake can absorb in one stop, or an emergency stop. During this stop almost no heat is dissipated and the brakewheel must be allowed to cool before the next stop. The second is the heat dissipation capability of the brake when it is frequently cycled.

To achieve optimum brake performance, the total calculated energy in the system referred to the brakewheel (Ft. Lb.) should not exceed the maximum energy ratings (Ft. Lb.) shown in Table 1. This should take into account overhauling loads, inertia, duty cycle, type of drive, motor control system and speed of load referred to brake shaft.

- If dynamic or regenerative braking is used to reduce the brakewheel speed automatically before the brake is applied, a smaller brake may be selected to satisfy the lower "service" energy requirement. The size is then primarily determined by the one (emergency) stop capability of the brake as shown in Table 1.

Brakewheel Capacity Data (Table 1)

Brake Wheel Size Dia. Width	Maximum Energy	
	Heat Dissipation per Hour for Frequent Stopping (1) Ft. Lb./Hour	Heat Absorbtion Capacity during one or Infrequent Stopping (2) Ft. Lb.
SBW/OBW		
4 x 2 1/4	330,000	44,000
6 x 3 1/4	730,000	96,000
8 x 3 1/4	980,000	129,000
8 x 4 1/4	1,280,000	168,000
10 x 3 3/4	1,410,000	186,000
10 x 4 1/4	1,600,000	211,000
12 x 5 1/4	2,300,000	312,000
13 x 5 3/4	2,800,000	371,000
15 x 6 1/4	3,500,000	465,000
16 x 6 3/4	4,000,000	536,000
19 x 8 3/4	6,200,000	825,000
23 x 11 1/4	9,700,000	1,280,000
30 x 14 1/4	14,100,000	1,900,000
ABW		
5 x 2 3/4	730,000	80,300
8 x 3 1/4	1,250,000	137,500
10 x 3 3/4	2,300,000	253,000
13 x 5 3/4	4,250,000	467,500
16 x 6 3/4	6,200,000	682,000
19 x 8 3/4	9,800,000	1,078,000
23 x 11 1/4	14,600,000	1,606,000
30 x 14 1/4	21,200,000	2,332,000

Hi-Tork™ Brake Range
Selection and Application Data

1) Values given are for reasonably evenly spaced stops using a Ductile Iron brakewheel with free air flow for cooling around outer surfaces, and approximately 300°F (150°C) brakewheel temperature with ambient temperature 68°F (20°C). For more than sixty (60) stops per hour, the maximum energy must de-rated.

2) The values are for one or infrequent stops per hour. The brakewheel must be allowed to cool to ambient temperature before the next stop.

- Brakes with extra shoe clearances and/or with wider shoes will result in higher energy figures. Also brakes with smaller shoe clearance and/or narrower shoe widths will reduce energy figures given in the table above.
- On applications where the brake is used for frequent stopping over a repeated duty cycle, the energy must be calculated for each part of the cycle (hoisting, lowering, etc.). The maximum brake duty is determined as follows:

$$\text{Cycles Per Hour} = \frac{\text{Maximum Energy per Hour (Table 1)}}{\text{Total Energy per Cycle}}$$

The energy dissipated in stopping a rotating load (kinetic energy converted to heat by brake per hour) can be determined from the following formula:

$$KE_R = \frac{WK2 \times RPM2 \times N}{5875}$$

Where:

KE_R = Kinetic Energy of Rotating Load (Ft.Lb/Hr)
WK2 = Total inertia referred to Brake Wheel (Lb.Ft.2)
RPM = Speed of Brakewheel
N = Number of Stops per Hour
5875 = Constant

- On bridge crane applications which have repetitive duty cycles, the brake absorbs repeated amounts of energy during successive stops. The hourly energy load for the equipment based on the duty cycle may be determined from the following formula:

$$KE_B = \frac{N}{232} ((WE)(VE)2 + (WL)(VL)2)$$

Where:

KE_B = Kinetic Energy (Ft.Lb/Hr)
N = Number of Stops per Hour
232 = Constant
WE = Unloaded Crane Weight (Tons)
WL = Loaded Crane Weight (Tons)
VE = Unloaded Crane Velocity (Ft./Min)
VL = Loaded Crane Velocity (Ft./Min)

BRAKE LININGS

The basic requirements of any brake is that it should provide the required retarding torque and not fail in service. If the friction surface temperature becomes excessive then the coefficient of friction between the lining and the brake drum or disc can be seriously reduced. This condition is generally referred to as brake “Fade”. Operating at these higher temperatures also increases the “wear rate” of the linings and high thermal stresses may cause surface cracking of the brake drums, or discs. It is therefore essential to limit the surface temperature and maintain a coefficient of friction within the design values.