Introduction
When selecting a brake for a specific application, several factors need to be considered: brake torque, stopping time and/or deceleration rate, brake mounting, thermal rating, environment and brake type.

Because IMPULSE® Adjustable Frequency Motor Controls for traverse and hoisting motions provide controlled speed regulation of the motor before the brake sets, the brake in these instances serves mainly as a holding or parking brake. Hoists with mechanical load brakes and other operations where the adjustable frequency drive is programmed for immediate stop at STOP command, (base block), such as emergency stops, require the brake to both retard and hold the load.

Non-overhauling loads such as those required for bridge and trolley motions require braking torque only to stop the load, and will remain at rest due to system friction. Overhauling loads, such as a crane hoist, have two requirements: the braking torque required to stop the load; and the torque required to hold the load at rest.

Motor-Mounted Disc Brakes Vs. Shoe Brakes
Electric disc brakes are satisfactory for certain crane applications. They are usually used as a brake-motor combination and as such are compact and easily mounted. They are available in torque ratings ranging from 1.5 Lb-Ft to 1,000 Lb-Ft. Disc brakes have a limited heat-dissipating capability compared to shoe brakes. Where frequent stops from full speed are required, their thermal capacity should be evaluated.

The rugged design and construction of shoe brakes makes them the brake of choice for heavy duty applications such as steel mill cranes, container cranes, and lock and dam gates. Shoe brakes are available in torque rating ranging from 6 Lb-Ft to 11,000 Lb-Ft. The thermal capacity of shoe brakes is adequate for most applications. However, some applications which require frequent stopping of high inertia loads may exceed the thermal capacity of the linings and cause these brakes to fade.

Remember, brakes (motor-mounted disc, or shoe), when used with IMPULSE Adjustable Frequency Drives serve mostly as parking brakes where the thermal capacity of the brake is not normally a concern. However, brakes also must be capable of retarding an overhauling load in an emergency condition (base block). The magnitude of the kinetic energy that brakes are required to absorb will vary in direct proportion to the squares of the velocities. When Ultra-Lift is enabled during lowering, brakes should be sized with this relationship in mind. For application assistance, contact Magnetek with WR^2 (Rotational Inertia) of the connected load, RPM, frequency of operation and other applicable data.

Determining Hoist Brake Torque Based on Motor Data
Brake torque ratings are expressed as nominal static braking torque: i.e. the torque required to begin rotation of the brake from a static, engaged condition.

The full load torque of a motor is a function of horsepower and speed and is commonly used to determine a brake's required torque rating. The required brake torque may be calculated from the formula:

$$T_{Lb\text{-}FT} = \frac{5{,}250 \times Hp}{RPM} \times \text{service factor}$$

AISE Standard No. 6 and OSHA Regulations state that the hoist brake is selected based on the torque required to hoist a rated crane load at the point where the brake is applied. CMAA Specification No. 70 states that the hoist brake is selected based on motor full load torque at the point where the brake is applied. (See formula above). All three standards require a hoist drive handling hot metal to be equipped with two holding brakes.

MAGNETEK
MATERIAL HANDLING

<table>
<tr><td></td><td></td><td colspan="4">Brake Torque Rating</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Basis for Selection of Brake Torque</td><td colspan="2">Hoist Drive with Single Brake</td><td colspan="2">Hoist Drive with Two Brakes Plus Controlled Braking Means</td></tr>
<tr><td>With Controlled Braking Means*</td><td>With Mechanical Load Brake</td><td>Handling Hot Metal</td><td>Not Handling Hot Metal</td></tr>
<tr><td>CMAA</td><td>Motor Full Load Torque</td><td>125%</td><td>100%</td><td>100%</td><td>100%</td></tr>
<tr><td>OSHA</td><td>Torque Required to Hoist Rated Load</td><td>125%</td><td>100%</td><td>100%</td><td>100%</td></tr>
<tr><td>AISE</td><td>Torque Required to Hoist Rated Load</td><td>150%</td><td>150%</td><td>125%</td><td>100%</td></tr>
</table>

This table is provided for reference only.

Hoist “controlled braking means” include dynamic, eddy current, regenerative or counter torque. IMPULSE·VG+ provides a safe and effective means of controlled braking. It is available as standard with dynamic braking (resistors) or with optional full regenerative braking (power returned directly to line).

Recommended Hoist Service Factors

	Shoe Brakes	Disc Brakes
Single Brake Hoists	150%	140%
Dual Brake Hoists – Non-Hot Metal	2 @ 100%	2 @ 100%
Dual Brake Hoists – Hot Metal	2 @ 125%	2 @ 125%

Bridge and Trolley Brake Selection

The table below provides guidelines for the application of brakes to bridge and trolley drives:

<table>
<tr><td rowspan="2">Application</td><td colspan="2">Interpretation</td><td rowspan="2">Recommendation</td></tr>
<tr><td>Bridge</td><td>Trolley</td></tr>
<tr><td>Cab-operated cranes with the cab located on the bridge</td><td>A bridge brake of the stopping or holding type is required.</td><td>A trolley brake is not required but one may be used to eliminate creep with the power off.</td><td rowspan="3">OSHA defines a brake as a device used for retarding or stopping motion by friction or power means.

A drag brake is a brake which provides retarding or stopping motion without external control.

A holding brake is a brake that automatically prevents motion when power is off.

AISE and OSHA specify that stopping brakes be selected to (1) stop the drive within a distance in feet equal to ten percent of full load speed in feet per minute when traveling at full speed with full load; (2) stop the drive from full load free running speed to zero speed at a deceleration rate equal to the acceleration rate for the drive.

Crane trolley and bridge brakes are commonly sized with a torque rating less than the motor’s full load torque (<100% service factor) to permit the trolley or bridge to coast, minimizing load swing.</td></tr>
<tr><td>Cab-operated cranes with the cab located on the trolley</td><td>A bridge brake of the holding type is required.</td><td>A trolley brake of the stopping or holding type is required.</td></tr>
<tr><td>Floor, remote and pulpit-operated cranes</td><td>A bridge brake of the stopping or holding type or non-coasting mechanical bridge drive is required.</td><td>A trolley brake is not required but one may be used to eliminate creep with the power off.</td></tr>
</table>

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Traverse brakes should have a torque rating of at least 50% of the rated motor torque.

Determining Stopping Time/Distance – Traverse Motions

Note: the following equations can be used to determine the stopping time and distance for traverse motions during emergency stops (or when AFD is programmed for base block) using only the mechanical brake for stopping.

The time or distance required to stop a moving bridge or trolley requires calculating the total system inertia reflected to the brake shaft:

$$WK_T^2 = WK_B^2 + WK_M^2 + WK_W^2$$

Where:

WK_T^2 = Total reflected inertia to brake ($Lb\text{-}Ft^2$)

WK_B^2 = Inertia of brake wheel ($Lb\text{-}Ft^2$) (from catalog data)

WK_M^2 = Inertia of motor ($Lb\text{-}Ft^2$) (from catalog data)

WK_W^2 = Equivalent inertia of moving load reflected to the brake shaft ($Lb\text{-}Ft^2$)(see formula below)

Calculate WK_W^2

$$WK_W^2 = W_{Lbs} \times \left(\frac{V_{fpm}}{2 \times \pi \times RPM} \right)^2$$

W = Total weight of bridge or trolley and load (Lbs)

V = Travel Speed (FPM)

Calculate

$$WK_T^2 = WK_B^2 + WK_M^2 + WK_W^2$$

Calculate Stopping Time

$$t_{sec} = \frac{WK_T^2 \times RPM_{@Brake}}{308 \times T_d}$$

Where:

T_d = Shoe brake torque rating (Lb-Ft)

or

T_d = Disc brake static rating (Lb-Ft) x 0.80

Calculate Stopping Distance

$$S_{Ft} = \frac{V_{fpm} \times t_{sec}}{2 \times 60}$$