What's the difference between stopping dynamically and holding a load with power off brakes? How do I correctly size a power off brake?

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The most significant difference is that with dynamic stopping the brake has to absorb the kinetic energy built up by the inertial loads in a dynamic situation. In such instances the brake transfers that energy resulting in heat build up and wear on the surfaces of the rotating components. With static holding, all rotating components come to a rest and the brake simply holds the load. As a result, no heat builds up and there is very little wear.

In most power off brake applications the brake is typically used to hold equipment in place when the power is removed from the motor or drive – similar to using the parking brake on your car. Even in applications that require only a holding brake some dynamic engagement can occur, and most power off brakes are designed to absorb that energy. For example, if brake response time is approximately 100 MS and motor response time is 20 ms, the brake can be dynamically engaged for 80 ms.

Dynamic Stopping within specified time

When it comes to sizing a brake for dynamic stopping, first estimate the torque required to stop the system inertia within an interval of time that suits the application. At this point only the load inertia will be known (once a particular brake is chosen you will need to accommodate for brake rotor inertia, friction disc and hub), so a general rule of thumb is to add 25% to the load inertia to estimate the brake rotor inertia.

For starters, the equation to determine the estimated average dynamic torque required to dynamically stop the load in an interval of time is:

$$T = (0.1047\,(I \times \omega) / t\,) - D$$

Where: 0.1047 is a factor that converts rad/sec to rpm
I = total system inertia (lb-in-sec²)
ω = RPM
t = Time to Zero (time it takes for the rotating shaft to stop in seconds.)
D = any drag torque in the system aiding the required brake torque
T = Average Dynamic Torque

Multiply the above results by 1.25 to convert to static torque (most brake manufacturers ratings are static torque, which is typically higher than average dynamic torque).

Please look for next month's column where more sizing and selection issues will be discussed.