Cooling linear motors

Linear motors produce a unique combination of high force and accurate movement that makes them useful in material handling, grinding, and large mold-making machines, just to name a few applications. However, getting the most out of a linear motor often goes beyond basic motor sizing and selection skills. Cooling linear motors is also crucial for optimized performance. Why?

Linear motors, like other direct-drive motors, are integrated directly into machine slides and mechanics to eliminate mechanical powertrain links such as ballscrews and gearboxes. But because the motors are directly coupled to machines, and not hanging at the end of a slide, the motors can transfer a lot of heat and degrade machine accuracy.

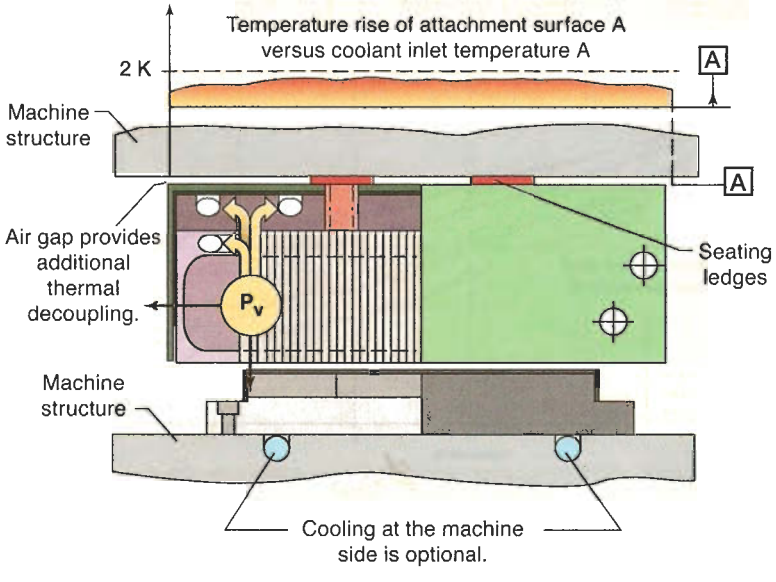
Therefore, designers must choose a cooling method appropriate for how the motor is used. In most cases, a closed-loop, liquid-cooling system with a chiller unit is best. Initial cost is high, but the savings realized (in allowing efficient motor sizing and better performance) more than makes up for that.

How does one size a chiller?

Chiller capacity (cooling capacity, flow, and pressure) must be suitable for the number of installed motors, their locations on the machine, and their respective loads. These factors determine the energy which must be dissipated — and the maximum expected temperature of the motors.

Height, tube diameter, and length influences the pressure drop of coolant, which in turn determines

Straight shooter



Coolant should only be a few degrees cooler than ambient temperature, to avoid condensation.

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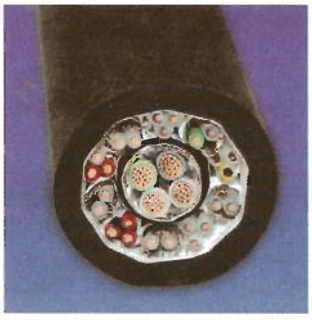

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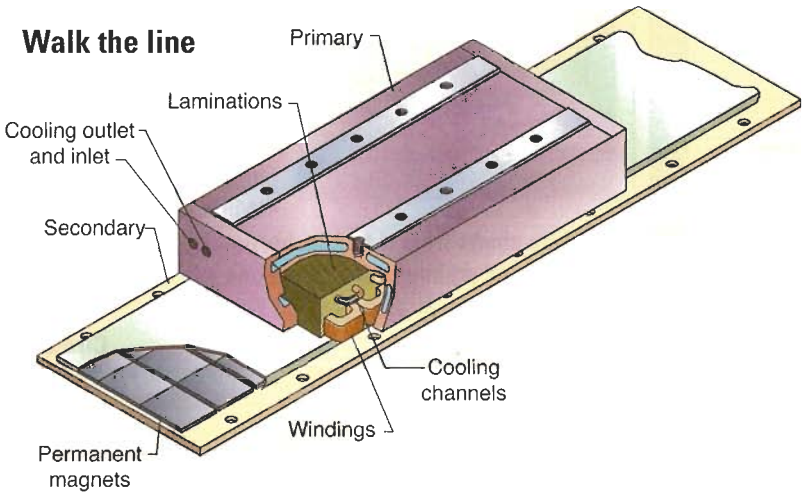

The overall height, tube diameter, and length of the cooling system determines the pressure drop of coolant — and appropriate pump size.

appropriate pump size. Pressure regulators and manifolds can ensure proper coolant flow to each motor. Here, flow meters in the cooling return pipe from each motor (or group of motors, if mounted in series) allows controllers to monitor flow.

How cool should coolant be?

Chiller units should have maximum and minimum coolant temperature settings. The nominal temperature should be set to the maximum ambient temperature of the motor, or a temperature sensor to monitor ambient temperature.

Either way, the temperature of the coolant should not be cooler than 9° F below ambient temperature, especially when the relative humidity is high, as damaging condensation will form on (and even in) the motors.

What kind of coolant is best?

You may use water or oil-based coolants, as long as the cooling system is closed, and the coolant is filtered and used solely for cooling motors. Tap water and service water are unacceptable, as is machine cutting coolant. Using these liquids to save on cost almost always costs more in the long run, as the chemical composition of these coolants results in precipitate buildup and coolant flow blockage. This in turn causes the motors to overheat.

Improper coolant can also cause chemical reactions between materials in contact with the coolant. This can result in corrosion and eventual leakage.

To prevent such issues, additives in the coolant should be used and a pH sensor installed to monitor the coolant itself. Machine controllers can then inform the machine operators when motor coolant needs attention.

This month's handy tips provided by Douglas Bruss, product support engineer at the Electric Drives and Controls Group of Bosch Rexroth Corp. For more information, e-mail Eric Deist at edeist@marketsense.com.

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