Choosing Between Air And Electric Clutch-Brakes

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To accommodate current industry demands for enhanced cost-effectiveness and productivity, machine builders must consider the performance capabilities and operational overhead of each component that goes into every design. Stopping and starting capacity are two of the most important performance aspects of machine automation, with inferior clutches and brakes having a direct impact on production efficiency and product quality.

With two leading technologies on the market, electric and air-actuated clutch-brakes, machine builders must perform a detailed evaluation of each option prior to incorporating one into their designs. When deciding what type of clutch-brake would best complement a machine as well as satisfy production end goals, users should consider response time, torque, longevity, energy consumption, horsepower, cost, and maintenance requirements.

Before selecting a clutch or brake solution, users should take into consideration the importance and impact of the seven primary performance characteristics.

1. Response Time
Response time is the increment of time from the initial moment the power is turned on or off at the control valve, to the time the clutch or brake responds with (full load) torque, or disengages and the torque begins to decay. A fast response time is key for any automated machine to preserve product quality and equipment integrity.

2. Torque Output
Transmitted torque must be considered for all applications of clutches and brakes. They can be selected for simply transmitting motor torque, providing torque for specific starts and stops within an increment of time, or for variable torque in tensioning applications.

Manufacturers provide selection tables, torque graphs, formulas, and selection programs that aid in the selection of the optimum size for any machine condition.

3. Thermal Horsepower

Thermal horsepower is the brake’s ability to dissipate generated heat, and is probably the most important characteristic of a clutch or brake. There are three types of thermal conditions that should be considered: peak input rate, heat sink, and continuous heat dissipation.

The peak input rate is the amount of heat energy that a clutch or brake disc can absorb without raising the temperature enough to permanently damage the friction interface.

Heat sink values represent the total amount of heat that a clutch or brake friction plate can absorb during a given period of time. It is a measure of the amount of heat required to raise the temperature of the friction plate, from ambient to a safe level below the threshold where checking and distortion could occur.

Continuous heat dissipation is a measure of the average rate that heat is generated at the friction interface without causing damage to any of the components. It is generally stated as horsepower at a specific speed.

All three types of thermal ratings are associated with the clutch or brake's ability to move heat away from the interface, absorb the heat, and transfer it to the surrounding air.

4. Facing Life

Clutches and brakes are subject to friction during operation and must provide good wear life even under severe conditions.

Engineers must know the friction material wear rate, the amount of usable volume of material, and the amount of energy that is absorbed by the friction lining each time the clutch or brake is engaged. These factors help determine the brake's ability to withstand friction wear.

Facing life is expressed in horsepower-hours that represent the total amount of scrubbing work that is done at the friction interface before facing replacement is necessary. The actual value depends on the wear characteristics of the facing material and the interface temperature.

5. Repair Costs

Given today's emphasis on productivity and efficiency, machine builders need components that promote these objectives. Stopping and starting mechanisms should have longer life spans with less maintenance, as repairs result in additional costs, halt production, and can ultimately reduce profitability.

6. Energy Consumption

Industry trends are moving towards reduced energy consumption and lower operating costs. By analyzing how much energy a braking solution will consume, users can determine its energy consumption, allowing them to choose a solution that requires less energy, decreases costs, and improves machine efficiency.

7. Unit Cost Savings

Along with the cost of equipment upkeep, the initial cost of implementation is also important. The unit cost represents the original investment, so comparing the price of each solution is a first step in determining the type of investment manufacturers are willing to make.

Performance Capabilities

When selecting any product, determining whether or not it will perform to the user's intended expectations is paramount.

Clutching and braking often need to be done quickly and with pinpoint precision. All friction clutches and brakes slip during engagement. The kinetic energy produced during slip converts to heat at the dynamic interface, which can negatively affect clutch-brake performance. When the temperature rises, the coefficient of friction goes down, resulting in a reduced torque output.

When similar electric and pneumatic clutch were compared, the air-actuated clutch transmitted 35 to 40 percent more torque because it operated at a lower temperature, while the electric unit experienced a dramatic drop in torque when the speed increased.

Electrically-actuated clutches are engaged by continuously passing an electrical current through an electromagnetic coil, which elevates the temperature of the entire unit. Alternatively, air-engaged brakes utilize static, pressurized air contained in a cylinder, maintaining a constant force and operating at lower temperatures than an electric unit. This allows pneumatic solutions to offer thermal horsepower as high as 0.14, while a comparable electric unit can only achieve a rating of approximately 0.10. Ultimately, air does not generate heat during clutch and brake engagement, allowing greater torque transmission and a longer operating life.