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Controls



Torque Limiting Brake



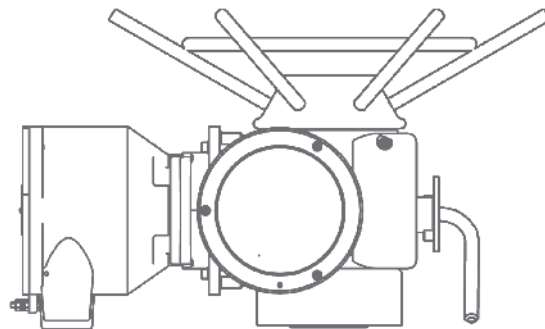
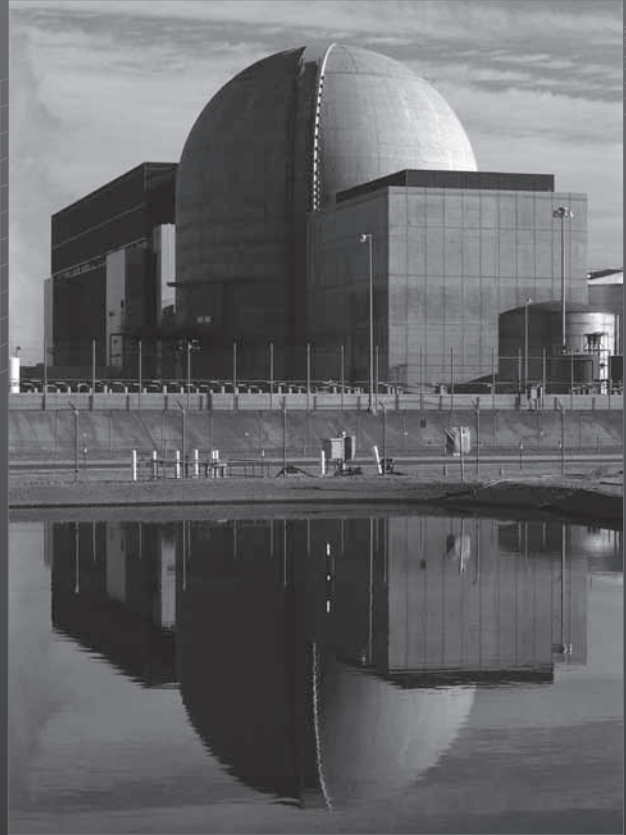
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**Use and operation of the
Rotork torque limiting brake**

Redefining Flow Control

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Torque limiting brake

Actuators for fast acting safety related valves are sized to ensure that they will operate under intense conditions. They often have to be over-motored to guarantee valve design torque or thrust, particularly where voltage drops in excess of 10% and high accident temperatures must be taken into account.

Under such conditions the maximum force to which the valve may be subjected under malfunction conditions may put the valve structure at risk. The Rotork torque limiting brake option provides a unique solution to this problem. Reference has been made to the fact that electro-magnetic brakes cannot protect against this condition, because they remain energised with the motor. The Rotork solution is entirely mechanical, and provides a means of ensuring that excess motor torque cannot be applied to the valve.

Factory setting:

The torque limiter is adjusted to engage the brake disc with the open and closed brake pads when the wormshaft movement exceeds the design torque setting, thus limiting the maximum torque to 2 times the actuator rated torque. This setting is locked in place during actuator calibration.

Construction

The construction is very simple, comprising of an extended motor housing and shaft, a brake disc and two brake pads. The motor shaft moves axially with wormshaft deflection against torque measuring springs, and the brake disc does the same.

If the deflection required to achieve torque switch trip at maximum setting is exceeded, the brake disc will engage the appropriate brake pad, causing instant braking of the motor. The greater the torque the motor is applying to the wormshaft, the greater the braking force. Because the brake is dealing with the lowest force at the input rather than the output end of the actuator, wear and tear on the brake is negligible through thousands of operations.

If the valve is under normal torque switch control, the brake is never engaged.

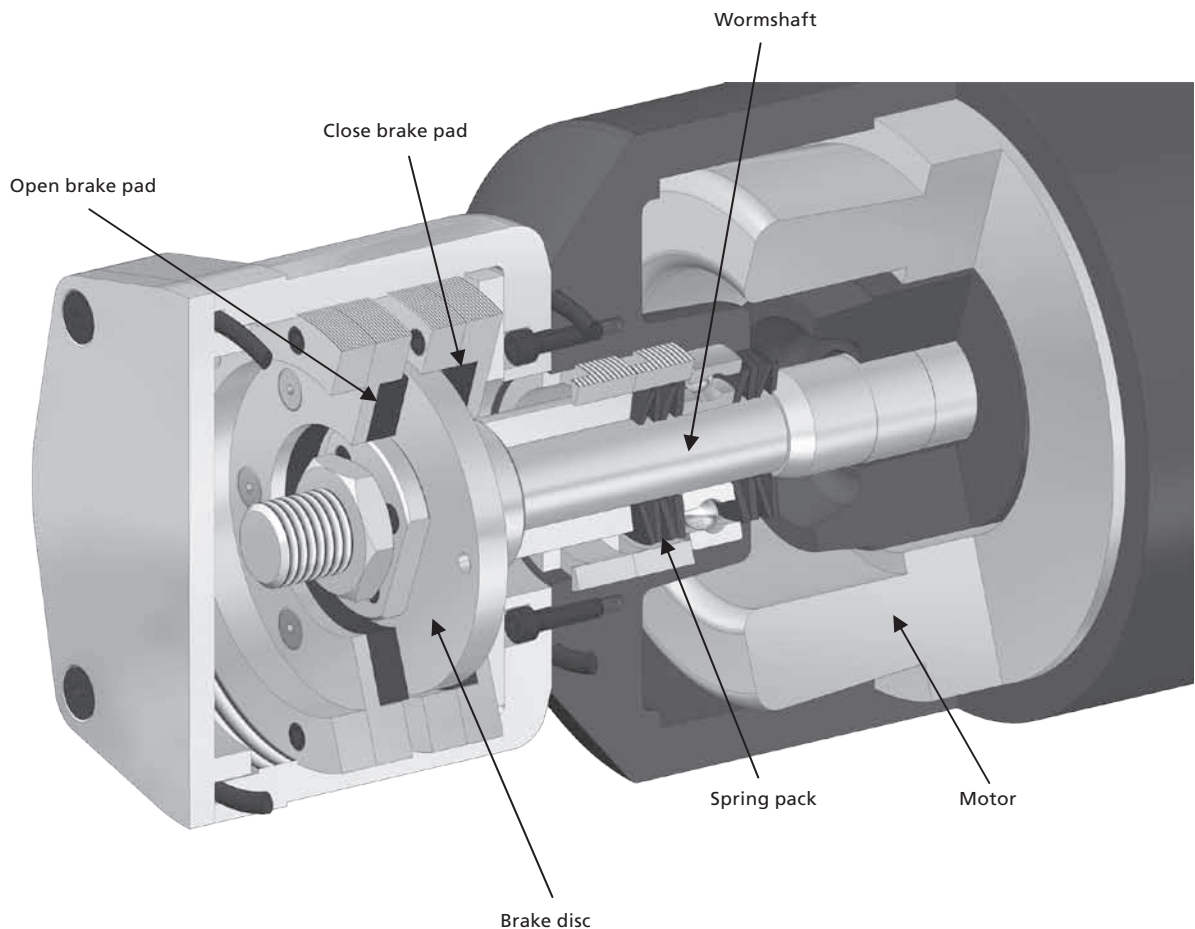


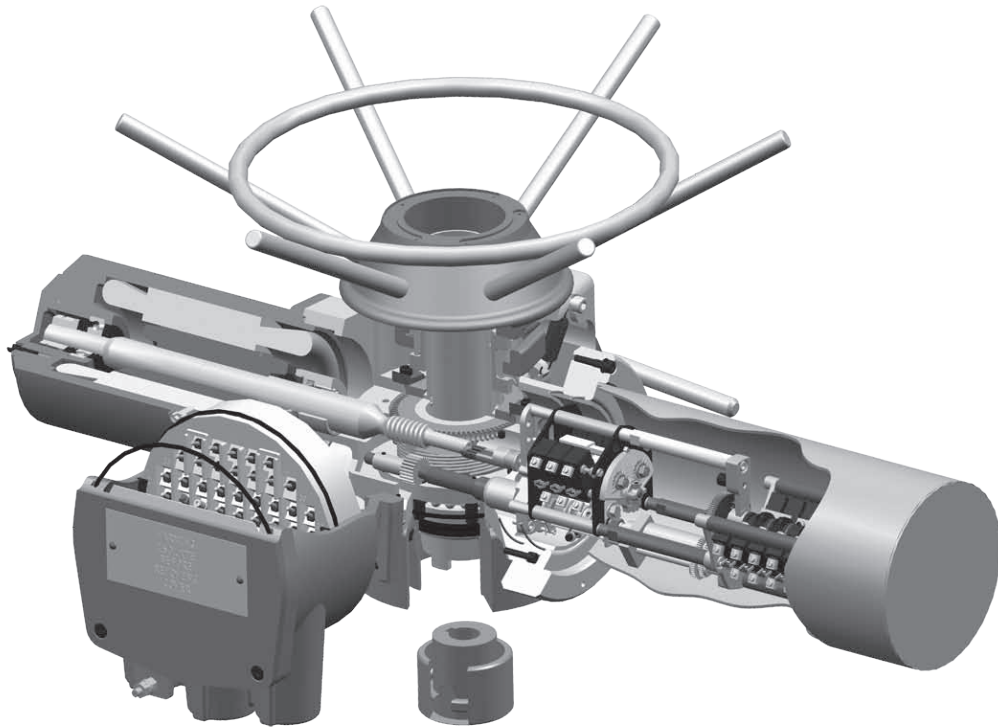
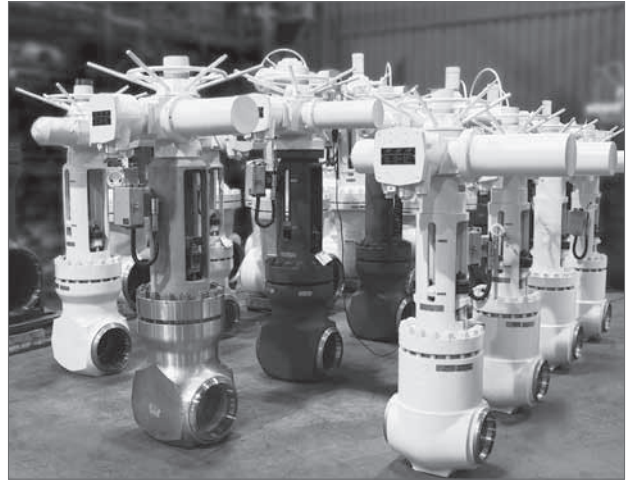
Fig. 1 - Typical Torque Limiting Brake assembly.

Torque limiting brake application

The primary objective of the torque limiting brake is to prevent damage to a valve in the event of the actuator being stalled, e.g. by incorrect wiring, incorrect phase rotation or electrical fault. The stall capability of safety related actuators has to be higher than normal to be able to guarantee performance during accident conditions of high temperature and reduced voltage.

Use of the torque limiting brake is particularly recommended for high speed valve operation where combined with actuator sizing for accident conditions. The resulting thrust can exceed 5 times the valve design thrust if the actuator stalls at maximum voltage supply and zero differential pressure.

It is impossible for Rotork to predict exactly the maximum forces to which a valve will be subjected under stall conditions, or the difference in torque seating forces between differential pressure and dry run conditions. This is due to the interaction of so many system variables like valve stiffness, friction, kinetic energy, efficiency variations, and so on. The torque limiting brake reduces the effect of those variables to insignificance and thus makes safety qualification of motorised valves much simpler.



Performance

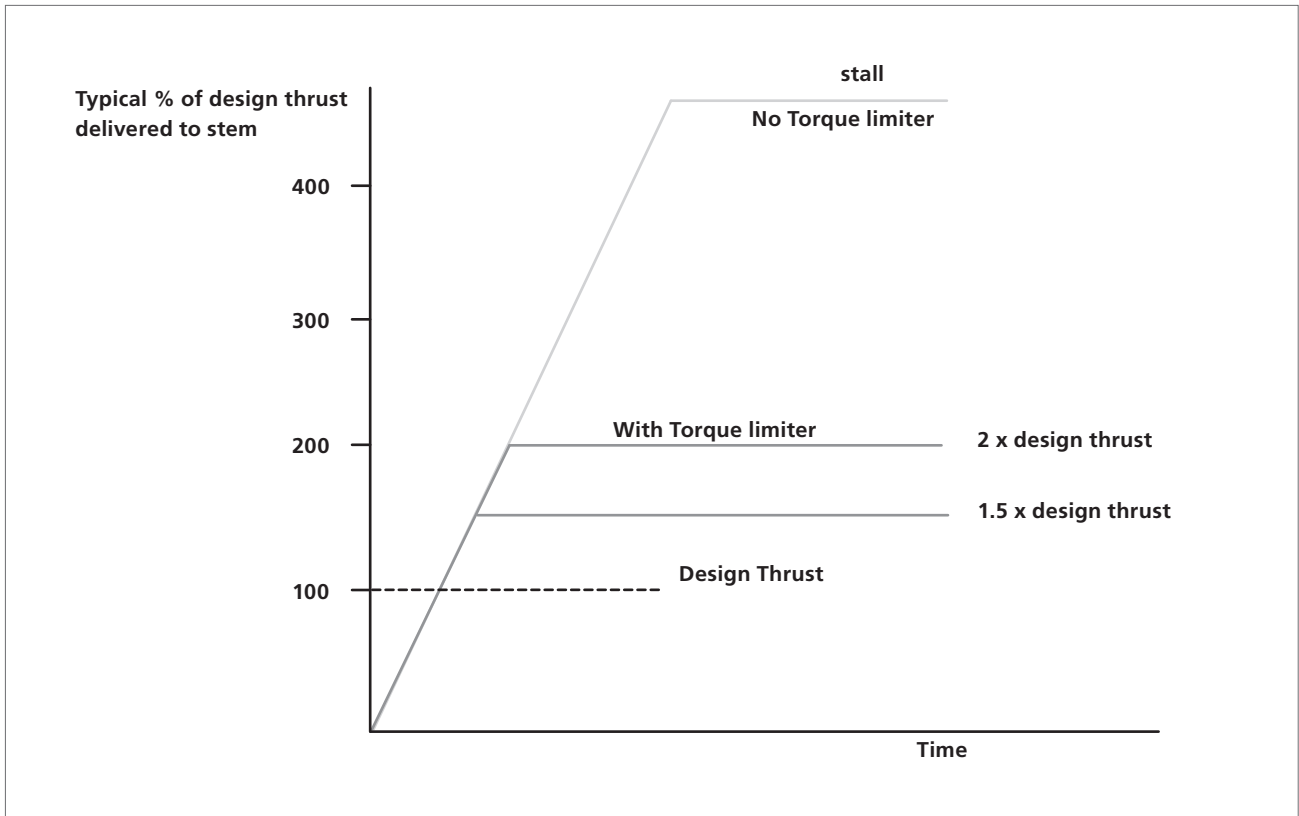


Fig. 2 - Effect of Torque Limiting Brake on actuator stall.

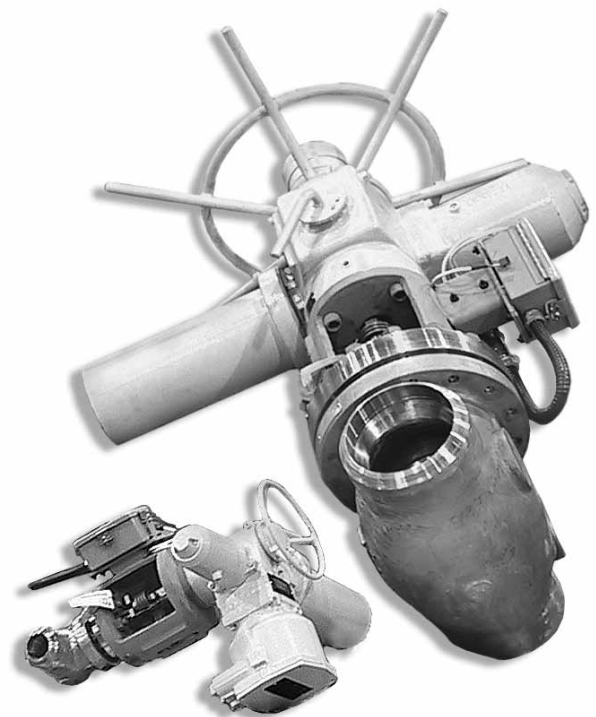
The graph in figure 2 shows the typical effect on valve thrust during actuator stall conditions. The slope of the curve is dependant on the valve stiffness.

To cater for voltage drop the actuator has to produce more torque at nominal voltage. For instance with a 30% voltage drop the actuator must produce at least 2.03 times the valve required torque. If the high temperature operation allowance is added the actuator has to produce almost 3 times the valve required torque.

Without the torque limiting brake the thrust developed at stall torque can be significant as shown above, especially if the actuator is stalled against a rigid valve with no differential pressure.

With the torque limiting brake fitted, the maximum torque delivered by the actuator and hence the maximum thrust delivered to the valve is limited to 1.5 – 2.0 times the valve required torque whatever operating conditions exist.

The Torque Limiting Brake provides assured protection of the valve.



Design Qualification

The torque limiting brake is environmentally qualified to IEEE382.



Designation of Actuator with Torque Limiting Brake

A 'T' is added to the actuator designation to denote a torque limiting brake. This includes types NAT1E, NAT5E, NDT1E, NDT5E, NET1E, NET5E.

The torque limiting brake can be fitted to 7NA, 11NA, 14NA, 16NA, 30NA, 40NA, 70NA and 90NA actuators.



Notes



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