

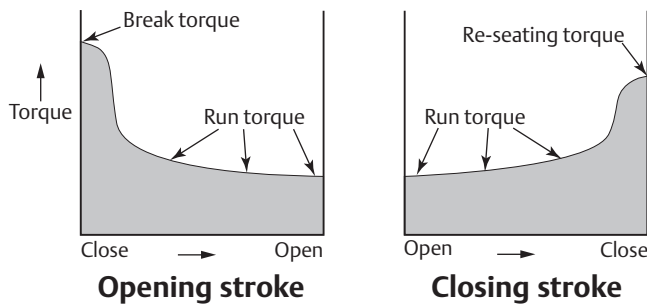
Sizing of Rack & Pinion actuators

Sizing is the selection procedure to select the right size of actuator on a valve with a given torque characteristic. This data sheet gives brief samples on how to size actuators and which data is needed.

Torque characteristics of valves

EL-O-Matic F-Series actuators are commonly used to operate butterfly-, ball- and plug valves. The below instructions are intended for these valve applications, but can also be used for other quarter turn applications.

Figure 1. Generic torque characteristic of a valve



Valve torque values and safety factors

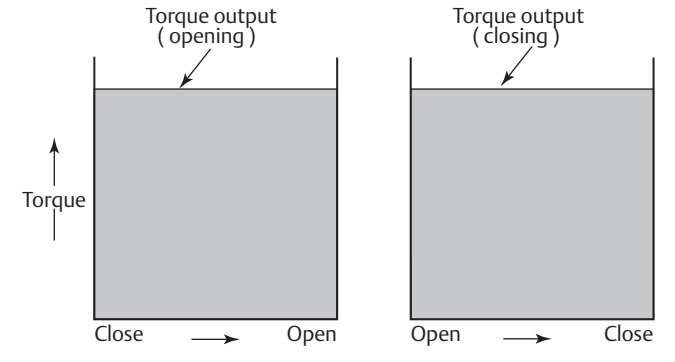
Emerson Process Management recommends that the valve manufacturer supply the maximum required and allowed torque values (Including any adjustments or suggested safety factors for valve service conditions or application).

Additionally, the valve manufacturer must identify at which position(s) and direction(s) of rotation (Counterclockwise or Clockwise) these maximum requirements occur.

If in doubt or if you require any assistance with sizing actuators, do not hesitate to contact your nearest Emerson's Actuation Technologies representative.

Sizing Double-acting actuators

Figure 2. Double-acting torque characteristic-



Sample calculation of double-acting sizing

- Publish valve break torque: 40 Nm 354 lbf.in
- Publish maximum stem torque: 105 Nm 929 lbf.in
- Recommended safety factor: 1.2 (20%)
- Minimum supply pressure: 5.5 bar 80 psi
- Maximum supply pressure: 6.5 bar 94 psi

Calculation:

1. Because the recommended safety factor is 1.2 the sizing torque will be $40 \times 1.2 = 48 \text{ Nm}$ ($354 \times 1.2 = 425 \text{ lbf.in}$).
2. Lookup in the double-acting torque table, in the 5.5 bar column (or 80 psi column), from top down, the first actuator size that generates more than 48 Nm (or 425 lbf.in).
3. Size FD65 is the first actuator that supplies more than
 - a. 48 Nm (71 Nm) at 5.5 bar.
 - b. 425 lbf.in (630 lbf.in) at 80 PSI.
4. The maximum torque output of a FD65 is 84 Nm (743 lbf.in). This is lower than the maximum stem torque of 105Nm.

Conclusion

Because FD65 supplies more torque than the sizing torque (see point 3) and less than the maximum stem torque (see point 4), size FD65 is suitable to operate this valve.

Sizing spring-return actuators

Figure 3. Spring-to-Close configuration

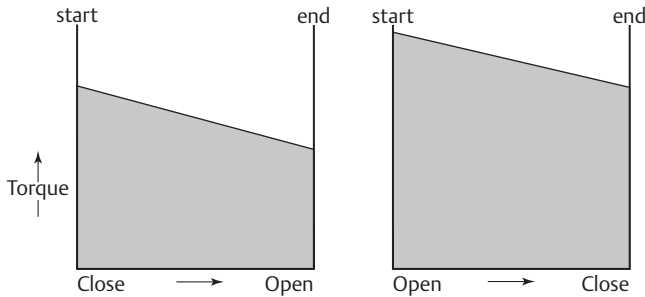


Table 1. For Fail-to Close actuators applies:

Actuator stroke:	Valve Stroke:
Air-Start torque	> Break torque and
Air-End torque	> Run open torque and
Spring-Start torque	> Run open torque and
Spring-End torque	> Re-seat torque

Table 2. For Fail-to Open actuators applies:

Actuator stroke:	Valve Stroke:
Spring-Start torque	> Break torque and
Spring-End torque	> Run torque and
Air-Start torque	> Run torque and
Air-End torque	> Re-seat torque

Sample calculation spring-return sizing for a Spring-to-Close application

- Published valve torques
 - Break torque: 150 Nm 1328 lbf.in
 - Run torque opening: 45 Nm 398 lbf.in
 - Run torque closing: 45 Nm 398 lbf.in
 - Re-seating torque; 90 Nm 797 lbf.in
- Publish maximum stem torque: 375 Nm 3496 lbf.in
- Recommended safety factor: 1.5 (50%)
- Minimum supply pressure: 5.5 bar 80 psi
- Maximum supply pressure: 6.0 bar 87 psi

Calculation:

1. Because the recommended safety factor is 1.5 the sizing torques will be:
 - Break 150 Nm x 1.5 = 225 Nm 1991 lbf.in
 - Run open 45 Nm x 1.5 = 67.5 Nm 597 lbf.in
 - Run close 45 Nm x 1.5 = 67.5 Nm 597 lbf.in
 - Re-seat 90 Nm x 1.5 = 135 Nm 1195 lbf.in
2. Lookup in the spring-return torque table, in the "spring end" torque column, from top down, the first actuator size that generates more than 135 Nm (or 1195 lbf.in) of re-seat torque.
3. Size FS350 with spring set 4 is the first actuator that supplies more spring end torque (149 Nm or 1655 lbf.in).
4. Check now for the other three positions whether the actuator torque exceeds the valve torques.

Actuator stroke:	Valve Stroke:
Air-Start: 252 Nm	> Break open: 225 Nm
Air-End: 157 Nm	> Run open: 67.5 Nm
Spring-Start: 232 Nm	> Run close: 67.5 Nm
Spring-End: 149 Nm	> Re-seat: 135 Nm

5. The maximum torque output of a FS350 with springset 4 at maximum pressure of 6 bar is 291 Nm (2575 lbf.in). This is lower than the maximum stem torque of 375 Nm (3496 lbf.in).

Conclusion

Because FS350 n=40 supplies more torque than the sizing torque (see point 3) and less than the maximum stem torque (see point 5), size FS350 n=40 is suitable to operate this valve.

Note:

- If the first found actuator does not exceed the valve torque at all the positions, check the next size actuator.
- If the next size actuator does exceed the valve torque at all the positions, but fails at maximum stem torque check whether the same actuator but with a higher springset (i.e. 50 instead of 40) does meet this requirement.