Bettis Actuators Selection Procedures

Scope: This book provides a condensed, easy to use selection/data base. It is intended for those entities and individuals that have an understanding of Bettis quarter-turn actuators and their applications. The information and instructions contained herein are not intended to cover every possible application or consideration. Bettis offers this technical data and general guidelines for the use and application of Bettis products. Only the user of a Bettis product can determine the suitability of a Bettis product for a specific application or use. Bettis encourages you to contact your local Bettis Valve Automation Center (VAC) or a Bettis manufacturing facility should you have any questions or concerns.

1.0 Bettis Definition

Over the years many different terms have been used in describing quarter-turn actuator fundamentals. To clarify and standardize terminology, Bettis offers the following definitions for terms commonly used. Please become familiar with and use the following standard definitions when referring to Bettis quarter-turn actuators.

General Definitions

A) **Quarter-turn:** A device which rotates a minimum of 90 degrees. All Bettis quarter-turn actuators will rotate more than 90 degrees.

B) **Position:** That degree of rotation describing an actuator's current location. The mid position of a quarter-turn actuator is generally at forty-five(45) degrees.

C) **CW:** Clockwise rotation.

D) **CCW:** Counterclockwise rotation.

E) **Stroke:** A continuous, ninety (90) degree rotation of a quarter-turn actuator. Bettis spring-return actuators have two (2) different strokes, a pressure stroke and a spring stroke. Bettis double-acting actuators have two (2) pressure strokes. Note that rack and pinon actuators have common torque valves for both pressure strokes, while scotch yoke actuators have different torque values depending on which side of the piston is doing the work.

F) **Cycle:** The collective reference to two (2) strokes, one (1) for clockwise (CW) rotation and one (1) for counterclockwise (CCW) rotation. Bettis actuators must rotate through two (2) stroke to complete one (1) cycle.

G) **Safety Factor:** Represents a protective component (an adjustment to torque requirement) sometimes added to a valve's required torque value. Often used when the user/specifier is not certain of the valves torque requirements, or because of other application concerns.

1.1 Definition Specific to the Pressure Stroke of Quarter-Turn Actuator Torque Charts

A) Start: (starting) That torque output position at which an actuator produces its greatest torque output. The starting torque outputs listed in Bettis scotch-yoke torque output charts are the lesser of the two (2) pressure strokes, when there is a difference (different areas).

B) Minimum: (min.) That torque output, at an intermediate position, at which an actuator produces its lowest torque output. The minimum torque outputs shown on Bettis pressure torque output charts are the lowest torque values produced during the pressure stroke(s). For double-acting actuators, this is also the mid position.

C) End: (ending) That torque output position at which an actuator has reached the limit of a pressure stroke. For double-acting actuators the end torque output is equal to the start torque output.

1.2 Definition Specific to the Spring Stroke of Quarter-Turn Actuator Torque Charts

Note: Spring-return, quarter-turn actuators use pressure and springs(s) to produce torque.

A) Start: (starting) That torque output position at which a spring-return actuator produces its greatest torque output during a spring stroke. The starting torque output listed in Bettis spring return torque output charts is that torque output position, where the spring is fully compressed, and capable of transferring its maximum force.

B) Minimum: (min.) That torque output, at an intermediate position, at which an actuator produces its lowest torque output. The minimum torque outputs listed on the Bettis spring torque output charts are the lowest value of torque output produced at any position, during either stroke (pressure or spring)

1.2 Definition Specific to the Spring Stroke of Quarter-Turn Actuator Torque Charts (continued)

C) End: (ending) That torque output position, at which an actuator has reached the limit of the spring stroke. The spring ending torque output values listed on Bettis spring-return torque outputcharts is the torque output value where the spring is fully extended and is transferring its lowest force value.

2.0 Initial Data Concerns for Sizing Bettis Actuators

The following information is generally the minimum required for sizing Bettis quarter-turn pneumatic and hydraulic actuators for specific valve requirements

A) An accurate maximum torque requirement must be obtained before actuator sizing begins. Normal maximum stem torque for a properly applied and maintained valve is usually defined as: The maximum starting torque required to rotate the valve element (ball, disc, plug, etc.) from a fully closed position (unsealing), against the maximum normal valve rated different pressures. Most valve manufacturers make adjustments in the form of torque amendments under various operating conditions. Application operating conditions such as temperature extremes, actual differential pressure, unusual loading, high flow rates, operating speeds, etc. are some of the most common causes for adjustments. Bettis recommends that the valve manufacturer supply the maximum required torque value(s) (Including any adjustments or suggested safety factors). Additionally, the valve manufacturer must identify at which position(s) and direction(s) of rotation (CCW or CW) these maximum requirements occur.

B) Bettis actuators include stops which will resist the maximum rated torque output of the actuator. The possibility exists, that should the valve become immobilized during rotation, the actuator could exceed the maximum allowable valve input torque rating. If this possibility is a concern, your application needs further review.

Once the maximum torque requirements, its position, and direction of rotation are identified, the appropriate Bettis actuator can be selected from torque output charts.

3.0 Bettis Initial Actuator Selection Procedures

A) Determine the type of Bettis actuator required: double-acting or spring-return; and then, rack and pinion or scotch-yoke.

B) Determine the power supply media: pneumatic or hydraulic, and the minimum/maximum supply pressure(s) at the actuator.

C) Using the above as minimum information, read section 4.0 and then select the applicable torque rating table and instructions listed as 4.1 through 4.6.

4.0 Specific Sizing Information (Read the following carefully)

The following information is designed to aid in sizing Bettis quarter-turn pneumatic and hydraulic actuators for specific valve requirements. The six examples that follow assume a valve/device which closes in a CLOCKWISE DIRECTION (CW) and has a maximum torque requirement at the unseating (Start) position.

Do not proceed past this point if you are not qualified or do not understand the application and use of Bettis actuators. Contact your local Authorized Bettis VAC or a Bettis manufacturing facility if you require assistance.

4.1 Bettis Rack and Pinion, Double-Acting Actuators (example assumes CW to close)

A) Using your minimum operating pressure, select an operating pressure column from the Pressure Torque Rating Section of less than or equal pressure. Select from that column a start/end torque output which exceeds the valve's maximum torque requirement. Determine the Bettis model number at the far left, in the model number column.

B) Once a Bettis actuator model has been selected, use the performance data tables to ensure your maximum supply pressure does not exceed the maximum operating pressure (M.O.P.) for the selected Bettis actuator. If the actuator selected is not rated for your maximum supply pressure, either the maximum supply pressure must be reduced or an actuator rated for a higher M.O.P. must be selected.

4.2 BETTIS Rack and Pinion, Spring-Return, Fail CLOCKWISE Actuators (example assumes CW to close)

Note: The valve's torque requirements must be exceeded by the actuator's torque output at all corresponding positions and directions of rotation.

Bettis has included Start and End pressure torque outputs, as well as Start and End spring torque outputs for your use.

A) Select from the Spring End column an output torque, which exceeds the valve's maximum seating requirement.

B) Proceeding to the right, and using your minimum operating pressure, select an operating pressure column from the Pressure Torque Rating Section of less than or equal pressure. The Pressure Start torque output must exceed the valve's torque requirement at this position (unseating) and direction of rotation (CCW). The Pressure End torque output must exceed the valve's torque requirement at this position (full flow) and direction of rotation (CCW).

C) Once a Bettis actuator model has been selected; use the performance data tables to ensure your maximum supply pressure does not exceed the maximum operating pressure (M.O.P.) for your Bettis actuator. If the actuator selected is not rated for your maximum supply pressure, either the maximum supply pressure must be reduced or an actuator rated for a higher M.O.P. pressure must be selected.

4.3 BETTIS Rack and Pinion, Spring-Return, Fail COUNTERCLOCKWISE Actuators (example assumes CW to close)

Note: The valve's torque requirements must be exceeded by the actuator's torque output at all corresponding positions and directions of rotation

Bettis has included Start and End pressure torque outputs, as well as Start and End spring torque outputs for your use.

A) Select from the Spring Start column an output torque, which exceeds the valve's maximum unseating requirement.

B) Proceeding to the right, and using your minimum operating pressure, select an operating pressure column from the Pressure Torque Rating Section of less than or equal pressure. The Pressure End torque output must exceed the valve's torque requirement at this position (seating) and direction of rotation (CW). The Pressure Start torque output must exceed the valve's torque requirement at this position (full flow) and direction of rotation (CW).

C) Once a Bettis actuator model has been selected; use the performance data tables to ensure your maximum supply pressure does not exceed the maximum operating pressure (M.O.P.) for your Bettis actuator. If the actuator selected is not rated for your maximum supply pressure, either the maximum supply pressure must be reduced or an actuator rated for a higher M.O.P. must be selected.

4.4 BETTIS Scotch-Yoke, Double-acting Actuators (example assumes CW to close)

Note: The valve's torque requirements must be exceeded by the actuator's torque output at all corresponding positions and directions of rotation.

Bettis has included Start, Minimum, and End pressure torque outputs for your use.

A) Using your minimum operating pressure, select an operating pressure column from the Pressure Torque Rating Section of less than or equal pressure. Move down the column until both starting and minimum output torques is found which exceed the valve's maximum and minimum torque requirements. Determine the Bettis model number at the left, under the model number column.

B) Once a Bettis actuator model has been selected; use the performance data tables to ensure your maximum supply pressure does not exceed the maximum operating pressure (M.O.P.) for your Bettis actuator. If the actuator selected is not rated for your maximum supply pressure, either the maximum supply pressure must be reduced or an actuator rated for a higher M.O.P. must be selected.

4.5 BETTIS Scotch-Yoke, Spring-Return, Fail CLOCKWISE Actuators (example assumes CW to close)

Note: The valve's maximum torque requirement must be exceeded by the actuator's torque output at all corresponding positions and directions of rotation.

Bettis has included Start, Minimum and End Spring Torque outputs, as well as Start, Minimum and End Pressure Torque outputs for your use. The minimum torque outputs listed on the Spring-Return torque charts are the lowest value of torque output available at any position, during either stroke (pressure or spring).

4.5 BETTIS Scotch-Yoke, Spring-Return, Fail CLOCKWISE Actuators (example assumes CW to close) (continued)

A) Select from the Spring Torque column a Spring Ending torque output, which exceeds that of the valve's maximum seating requirement.

B) Proceed to the right using your minimum operating pressure and select an operating pressure column for the Pressure Torque Rating Section of less than or equal pressure. The Pressure Start torque output must exceed the valve's torque requirement at this position (unseating). The Pressure End torque output must exceed the valve's torque requirement at this position (full flow) and direction of rotation (CCW)

C) Once a Bettis actuator model has been selected; use the performance data tables to ensure your maximum supply pressure does not exceed the maximum operating pressure (M.O.P.) for your Bettis actuator. If the actuator selected is not rated for your maximum supply pressure, either the maximum supply pressure must be reduced or an actuator rated for a higher M.O.P. must be selected.

4.6 BETTIS Scotch-Yoke, Spring-Return, Fail COUNTER CLOCKWISE Actuators (example assumes CW to close)

Note: The valve's torque requirements must be exceeded by the actuator's torque output at all corresponding positions and directions of rotation

Bettis has included Start, Minimum and End Spring Torque outputs, as well as Start, Minimum, and End Pressure Torque outputs for your use. The minimum torque outputs listed on the Spring Return torque charts are the least amount of torque output available at any position, during either stroke (pressure or spring).

A) Select from the Spring Torque column a Spring Start torque output which exceeds that of the valve's maximum unseating requirement.

B) Proceed to the right using your minimum operating pressure and select an operating pressure column from the Pressure Torque Rating Section of less than or equal pressure. The Pressure End torque output must exceed the valve's torque requirement at this position (seating). The Pressure Start torque output must exceed the valve/s torque requirement at this position (full flow) and direction of rotation (CW).

C) Once a Bettis actuator model has been selected; use the performance data tables to ensure your maximum supply pressure does not exceed the maximum operating pressure (M.O.P.) for your Bettis actuator. If the actuator selected is not rated for your maximum supply pressure must be reduced or an actuator rated for a higher M.O.P must be selected.

5.0 PERFORMANCE DATA

A) To determine the cubic inch displacement per stroke, maximum operating pressure (M.O.P.), maximum allowable working pressure (M.A.W.P.) or the approximate weight, refer to the Performance Data section of this book. Locate your model number in the far left, Actuator Model column and proceed to the right until you have located the desired information block.

B) **Be certain to read and understand all of the applicable notes.**

6.0 DIMENSIONS

To find outline and mounting dimensions for a particular model, simply turn to the Dimensions section of this book. Locate your desired actuator drawing and refer to the Dimension Table for actuator model number and "lettered" callout dimension.