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BECK® ELECTRIC ACTUATORS

FOR INDUSTRIAL PROCESS CONTROL

ELECTRIC UTILITY INDUSTRY

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Increasing Environmental and Economic Pressures Necessitate Control Improvements

Today's utility industry is characterized by ever increasing emission regulations, rising fuel costs, and a growing need to be competitive. Optimizing and maintaining control performance and minimizing downtime are critical to meeting these challenges. In response, power producers are continually investing in control systems and instrumentation to meet regulations, reduce costs, and avoid costly trips and outages. In addition, as new capacity is built, these plants will also require state-of-the-art control and high levels of reliability.

Beck actuator installed on a parallel blade inlet damper.

Damper and Valve Actuation is Key to Improved Boiler Control and Efficiency

In spite of the critical role of boiler control dampers and valves with respect to efficiency, safety and reliability, their performance is often ignored. In many cases, actuator problems tend to be addressed only after a serious or complete failure occurs. The rest of the time, poor performance goes undetected, or the impact it has on control is underestimated.

Poor damper and valve performance is a leading source of combustion control problems, often limiting ramp rate, contributing to boiler emission problems, or impacting heat rate. Pneumatic actuators are highly susceptible to stick / slip response, excessive dead time, inconsistent performance with changing conditions, and performance degradation over time. As a result, pneumatic actuation simply cannot provide the level of control performance provided by Beck actuators; nor can it provide the benefits of consistent and reliable performance over time and in harsh conditions. Similarly, typical electric actuators are poorly suited for active boiler control, since most are limited by motor duty cycles, provide less accurate positioning capabilities, and are less reliable—especially in the harsh operating conditions for which Beck actuators are designed.

Beck actuator installed on a coal mill exhauster damper.

Beck replacement installed on an ID fan damper. Note obsolete pneumatic line.

Beck Group 22 actuator installed on a damper.

Over a Thousand Utility Boilers are Benefiting from Beck Actuators ... and the Number is Growing

Investments in advanced control instrumentation and logic are very necessary, as is the addition of new plant systems (e.g., Overfire Air and SOFA), which are required to better control combustion emissions. However, the investments are only as effective as the precision, reliability and responsiveness of the dampers and valves. Many utilities understand this, and replace pneumatic actuators and typical electric actuators with Beck actuators. In fact, Beck actuators are modulating the dampers and valves of **over 1,000 electric utility boilers**. In addition, Beck actuators are also installed in modulating applications on **over 600 industrial boilers** of all sizes and styles.

Beck Actuators Improve Control and Eliminate Typical Actuator Problems

Why do Beck actuators improve control and eliminate the inherent problems of pneumatic actuators and typical electric actuators?

- Beck actuators respond to a modulating controller demand signal instantaneously, regardless of changing loads and conditions. Therefore, Beck actuators will not stick or slip like pneumatic actuators, thus eliminating dead time and position overshoot.
- Beck actuators track the controller demand signal closely under closed-loop conditions, with resolution unmatched by pneumatic and typical electric actuators, ensuring responsive, tight, and stable process control.
- Beck actuators provide consistent control over time with virtually no maintenance requirements.
- Beck actuators eliminate the dependence on costly and unreliable air systems, thus eliminating problems like freezing and contamination.
- Weather, dust, dirt, and temperature (-40 to 185° F.) conditions do not affect performance.
- The extreme ruggedness and quality of Beck actuators simply means that they will outlast and outperform other actuators, thus minimizing unit trips and downtime.

All Types of Applications Benefit from Beck Actuators

Whether a boiler is large or small, subject to severe load swings or base-loaded, Beck actuators provide the best possible damper and valve control. Some of the biggest benefits are realized on boilers subject to extreme load swings, high turndown, or demanding ramp rates. In these cases, Beck actuators have shown that the instantaneous response capability, without overshoot, provides exceptionally smooth and fast load change response. Likewise, boilers with active loads or other external disturbances benefit from the actuator's ability to track a demand signal closely, without modulation restrictions and performance inconsistencies.

Improving final control element positioning while eliminating dead time and overshoot, always results in better process control. Loops not only perform better, but also are easier to tune, stay tuned longer, and are more tolerant of varying conditions. Therefore, all applications benefit from Beck actuators, and Beck has a actuator for almost any boiler application.

Beck actuators are used plant-wide on all types and sizes of applications. General applications include:

- Control dampers
- Burner tilt and SOFA tilt control
- Fluid couplings
- Control valves

Sharing many common components and a unique design, Beck actuator product lines can meet the needs of almost any utility application and provide performance and reliability unmatched by other actuator technologies.

The **Group 11** product line is designed for low to medium torque applications from 20 lb-ft up to 1,800 lb-ft.

The **Group 22** product line is designed to meet the requirements of high torque damper applications ranging from 3,000 lb-ft up to 8,000 lb-ft.

For additional information on product specifications or more specific application details, contact a Beck Sales Engineer at 215-968-4600, or visit our website at *www.haroldbeck.com*.

Group 11 actuators deliver stable control for burner tilts.

Beck actuators on fluid couplings provide fast response and accurate speed control for boiler feedwater pumps and fans.

Group 14 linear actuators on condensate return valves.

Group 11 actuators provide precise control of secondary airflow on windbox dampers.

BEFORE AND AFTER COMPARISON OF A BECK REPLACEMENT ON A PARALLEL BLADE DAMPER

Old pneumatic actuator

New Beck replacement

Field Proven Results

Utilities are continually investing in Beck actuators and realizing the long term benefit. Below are a series of data charts that were generated by one such Beck actuator user.

Figure 1A

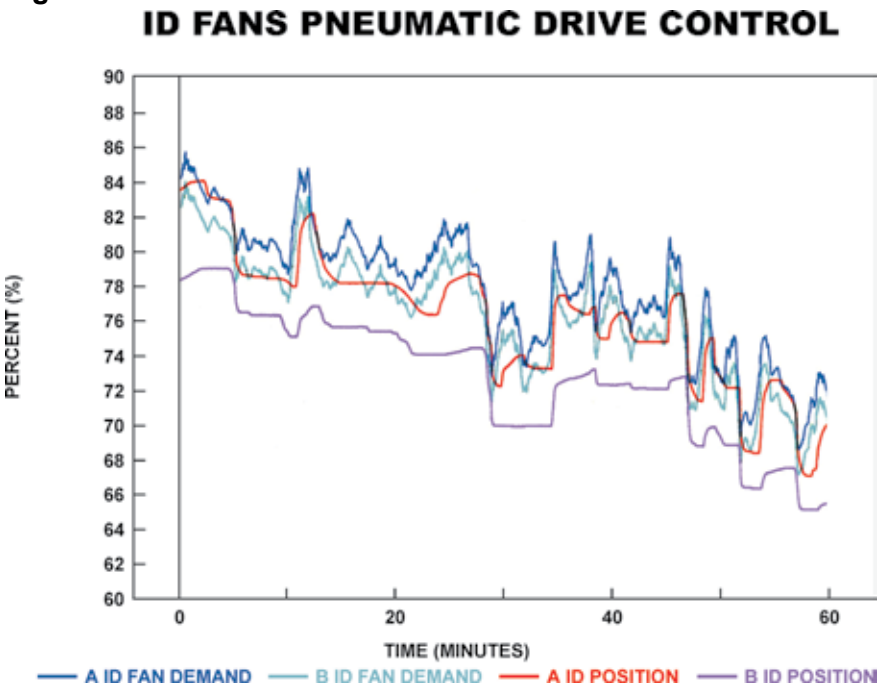


Figure 1A shows data for a boiler with dual ID dampers modulated with pneumatic actuators. Both dampers' actuators receive the same demand signal which is shown biased for clarity. The corresponding damper responses are shown as well. Neither damper actuator could follow the signal closely enough to provide good furnace pressure control. Additionally, although dampers, damper actuators and the controller demand signal are identical, the actuators performed differently from one another. This highlights not only poor response, but the typical inconsistent response of pneumatic actuators as well.

Figure 1B

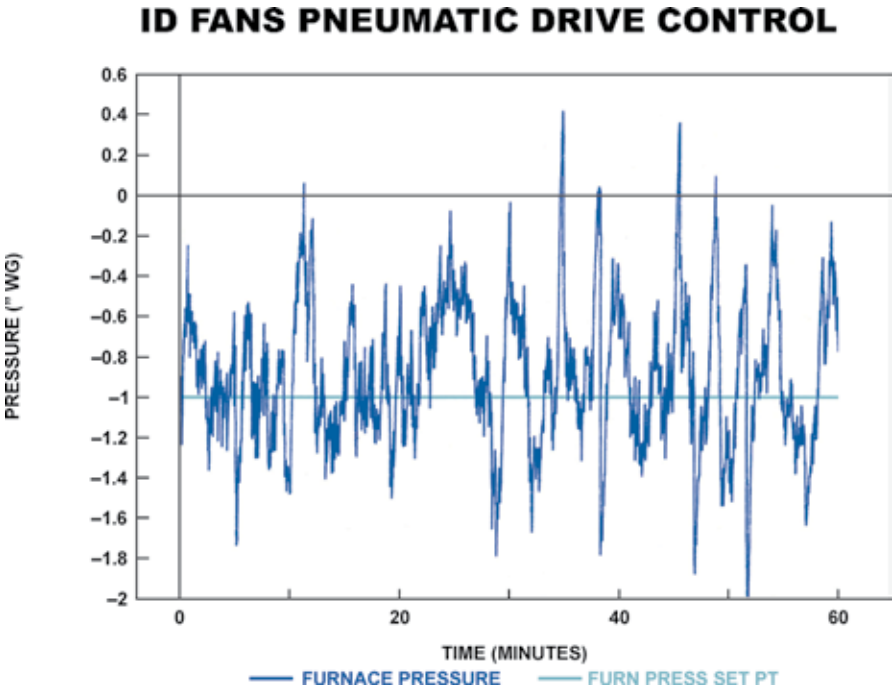


Figure 1B shows the resulting furnace pressure control with the pneumatic actuators in place. Note the following: 1) The pressure control is poor with a wide band of variability; 2) the furnace pressure occasionally goes positive; 3) the control setpoint is set at –1 inch of water column. Compare these results to Figure 2B after Beck actuators were installed.

Figure 2A

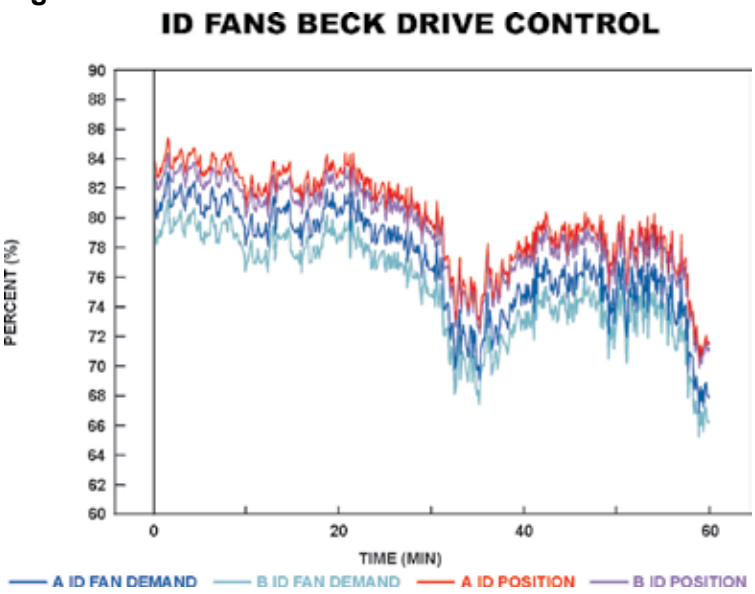


Figure 2A shows the response of the two ID dampers after Beck Electronic Actuators were installed. As in Figure 1A, biases were added to all the signals for the sake of display clarity, but the two demand signals are identical and the position signals actually overlay the demand. Note how closely the damper position tracks the demand, allowing for optimal furnace pressure control.

Figure 2B

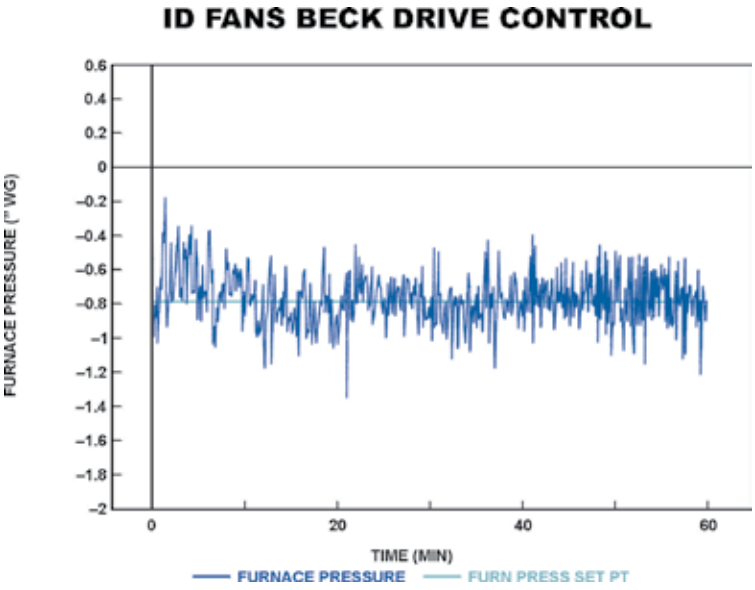


Figure 2B shows the furnace pressure control after the Beck actuators were installed. It is easy to see at a glance how much tighter the control results are compared to Figure 1B; however, it is also important to note the following: 1) Furnace pressure no longer makes positive excursions; 2) the loop setpoint has actually been moved from –1 in WC to a more efficient –0.8 inches WC; 3) this data was collected after the Beck actuators were installed, but before any tuning or other changes were made.

Figure 2C

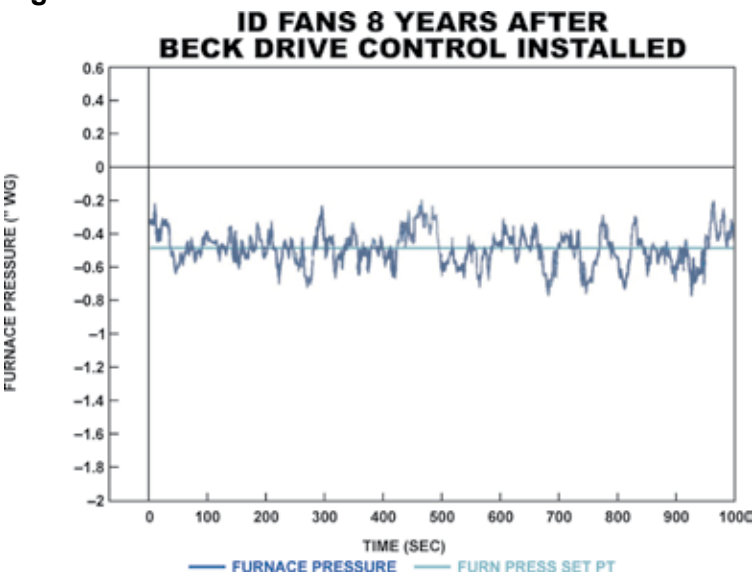


Figure 2C shows data collected on the ID dampers eight years after the Beck actuators were installed. Clearly, performance is still excellent. Further control improvements over the years allowed the furnace pressure setpoint to be moved from –0.8 inches WC to –0.5 inches WC; further accentuating the benefit of excellent damper control.

The following charts show before and after positioning from another large utility.

Figure 3A

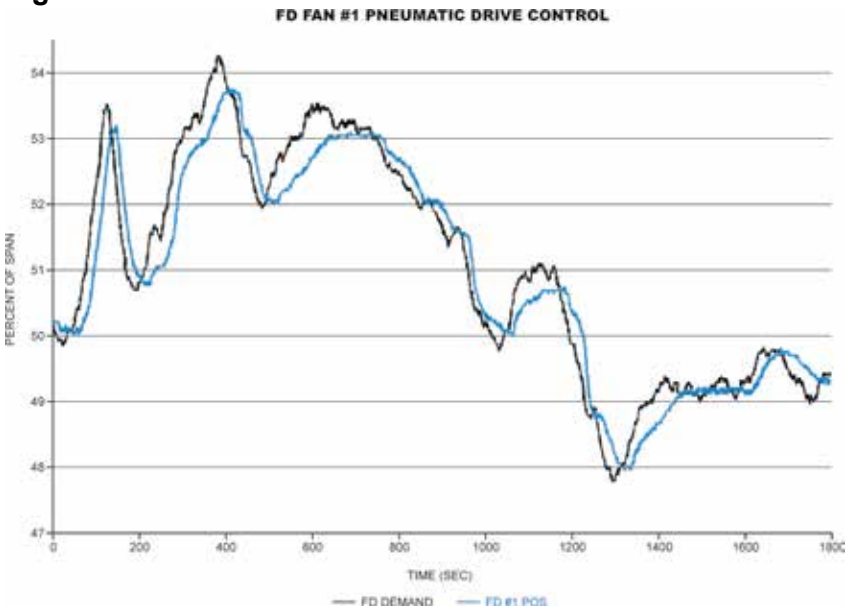


Figure 3B

Figures 3A and 3B show the positioning capability of two identical, pneumatically actuated FD dampers on 9000 HP fans. Since both fans service the same boiler, both fan dampers receive the same controller demand signal, although they respond in different manners. Damper #1 (**Figure 3A**) indicates that the response is sluggish, while damper #2 (**Figure 3B**) is even more sluggish and, in some instances, completely non-responsive. The significant amounts of dead time and lag created airflow control problems that limited the unit's ability to respond to MW load changes. Furthermore, the inconsistency of performance between the two fan dampers also created control problems and interactions.

Figure 4

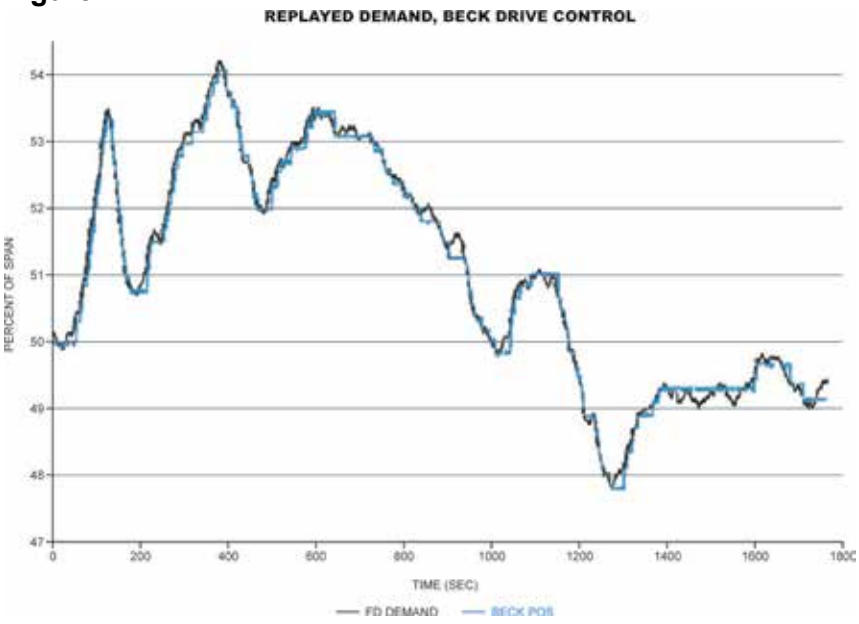


Figure 4 shows the same demand signal depicted in **Figure 3A and 3B** replayed to a large Beck actuator that the plant wanted to install in the FD damper applications. The actuator was fully loaded to simulate the actual operating conditions. The data provides a comparison between the pneumatic actuator response and the response the plant expected to achieve with the Beck actuator installed. The Beck actuator is able to almost perfectly follow the demand signal, even at full load.

Figure 5A

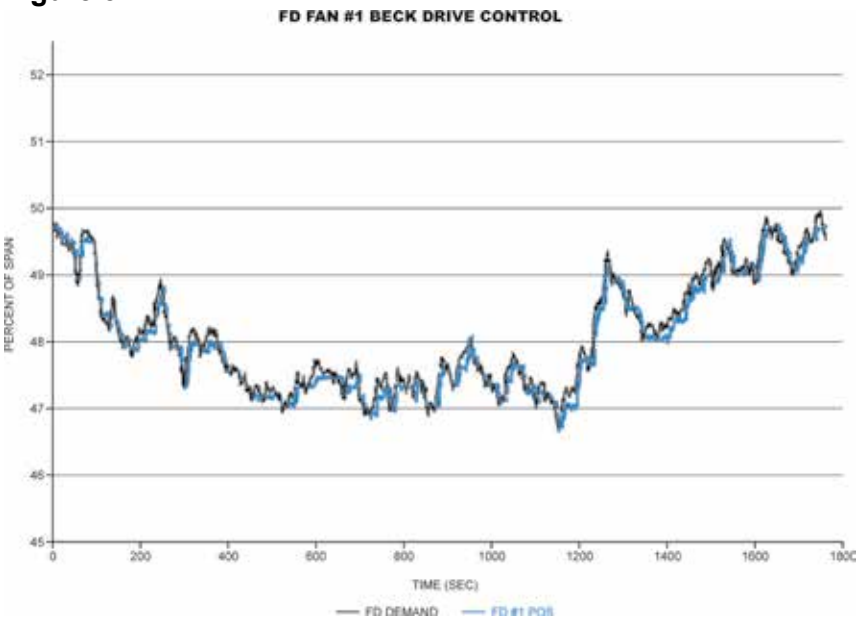
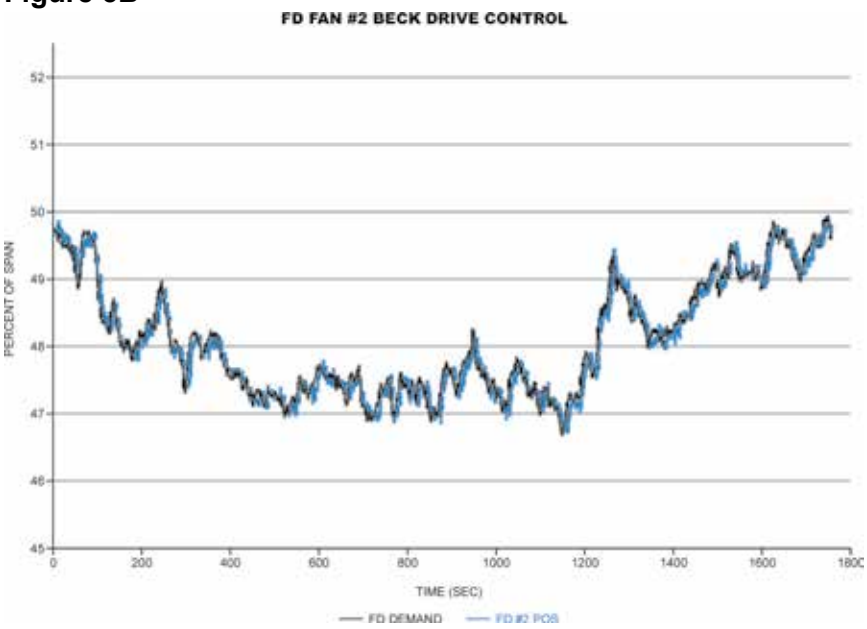


Figure 5B



Figures 5A and 5B show data collected for the same two FD fan dampers 3 years after the Beck actuators were installed. Clearly, the Beck actuators are not only following the demand very closely, but also providing consistent performance between the two FD fan dampers. The plant, therefore, improved control of the unit, increased efficiency, and increased ramp rate to more effectively meet megawatt load control demands. The plant was also able to maintain this improved performance over time. The addition of Beck actuators on most of the boiler damper applications made the performance even better and easier to maintain.

Beck's Unique Design Incorporates Simplicity, Flexibility, Reliability and Performance

Not only are Beck actuators designed to eliminate the shortcomings of other actuators, the many unique design features make them easy to install, easy to operate, reliable, maintenance-free and durable. The design also results in unbeatable control performance that remains consistent over time and with changing conditions.

Digital Electronics:

Repeatable Control, Simple Operation, and Diagnostic Capabilities

Beck actuators are equipped with field-proven electronics that provide excellent position control in response to modulating control signals. This maximizes control loop performance by ensuring that the actuator and damper respond exactly as the control loop requires.

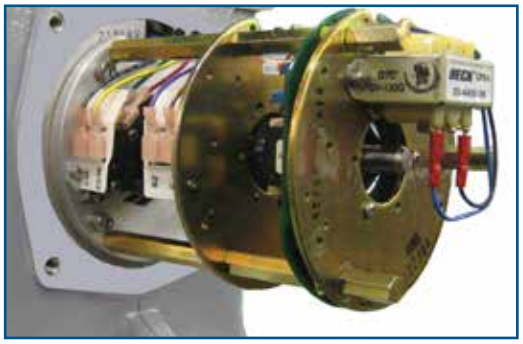
The DCM is equipped with a local interface panel for pushbutton calibration functions without the need for external devices or software. LED diagnostic lights display a number of status conditions.

The DCM is also equipped with a HART communications interface to provide bidirectional digital communications with the DCM over the existing analog demand wiring—facilitating access to the added functions and information without interfering with control or requiring new wiring. Communications can be accomplished either remotely or locally using any standard HART-based communication tool.

In addition to HART, other DCM versions are available that support Foundation Fieldbus, Profibus PA or Modbus RTU communications. Modbus TCP (Ethernet) is supported using a Modbus RTU DCM along with an interface module. All interfaces are compatible with common asset management systems.

A serial interface also allows for actuator configuration changes, actuator information reporting and assistance in troubleshooting.

Beck's Contactless Position Sensor (CPS) also resides within the actuator, and provides reliable internal position feedback to the DCM for position control. The DCM also uses the sensor signal to source a 4–20 mA external position signal for remote monitoring of actuator position. Unlike typical position sensors, the CPS does not wear due to its contactless design.



Actuator Train:

Precision and Durability

Beck's durable gear train maintains accurate, consistent positioning even under the demanding conditions of an active control loop.

Gear train features include:

- Efficient, all spur gear construction using only heat-treated alloy steels and ductile iron.
- Wide face gears that virtually eliminate wear induced backlash and positioning inaccuracies.
- Integral Self-Locking Mechanism (SLM) holds up to 200% of the rated load with the motor de-energized.
- Virtually no lubrication maintenance required and no mounting orientation restrictions on most models.

The Beck Motor:
No Burnout, Continuous Duty

The unique motor is one of the features that sets Beck actuators apart from other typical electric actuators. Beck's no burnout motor ensures that the actuator is available 100% of the time. There are no duty cycle limitations typical of most electric actuators, so the Beck actuator tracks the control signal perfectly, greatly simplifying loop tuning.

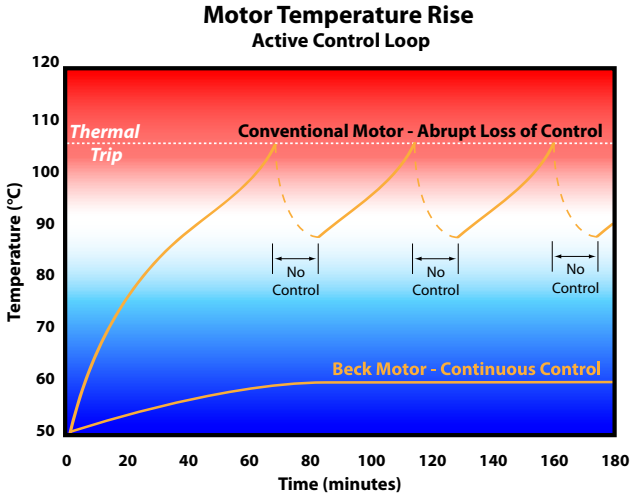
The Beck motor:

- Reaches full speed and torque in milliseconds—eliminating dead time.
- Stops instantaneously—eliminating coast and overshoot.
- Provides extremely accurate, repeatable positioning with no required maintenance.
- Draws very low current (0.16 to 3.0 A in most applications) permitting easy integration with UPS systems.

And . . .

- Never overheats or burns-out; even under demanding modulating or stalled conditions.

Tested in an active modulating loop, conventional motors rose rapidly in temperature, tripping thermal overload devices and becoming unavailable for extended time intervals. Only the Beck motor remained stable for continuous operation.



Local Manual Control

All Beck actuators are built with local positioning capabilities. An electric Handswitch allows electrical local operation of the actuator, while a convenient Handwheel, or Handcrank on some high torque drives, allows manual positioning of the actuator output shaft without electric power.

The electric Handswitch allows the actuator to be positioned locally and is very useful for the initial setup of the actuator and linkage. It also serves as a diagnostic tool or a backup control device in the event the loop controller or demand signal malfunctions.

Even in the absence of power, and with full load applied, the actuator output shaft can be manually positioned using the easy-to-turn, spoke-free Handwheel. No clutch mechanism is required and mechanical stops protect against manual overtravel.

GENERAL SPECIFICATIONS

Actuator Power	
Model 11	120 V ac, single-phase, 60 Hz (50 Hz Optional) (208, 240, 380, 415, 480 & 575 V ac, 60 or 50 Hz Optional)
Model 14, 29 & 42	120 V ac, single-phase, 60 Hz (50 Hz Optional) (240 V ac, single-phase, 60 or 50 Hz Optional)
Model 22-309	120 V ac, single-phase, 60 or 50 Hz (240 V ac Optional) (208, 240, 380, 416, 480, 575 V ac, three-phase, 60 or 50 Hz Optional)
Model 22-409	208 V ac, three-phase, 60 or 50 Hz (240, 380, 416, 480, 575 V ac Optional)
Model 22-809	480 V ac, three-phase, 60 or 50 Hz (208, 240, 380, 416, 575 V ac Optional)
Model 75	120 V ac, single-phase, 60 Hz (50 Hz Optional)
Output Torque/Thrust	
Model 11	Up to 1,800 lb-ft (2440 N•m)
Model 14	Up to 4,000 lbs of thrust (17800 N)
Model 22	Up to 8,000 lb-ft (10846 N•m)
Model 29	Up to 6,100 lbs of thrust (27134 N)
Model 42	Up to 1,000 lbs of thrust (4450 N)
Model 75	Up to 80 lb-ft (108 N•m)
Operating Conditions	–40° to 185° F (–40° to 85° C), 0 to 100% relative humidity
Input Signal Options	4–20 mA or 1–5 V dc
Communication Interface Options	HART, Modbus RTU, Modbus TCP (Ethernet), Foundation Fieldbus, Profibus PA, local pushbutton/LEDs and DB9 Serial Commands
Position Feedback Signal	4–20 mA
Action on Loss of Input Signal	Stays in place (all models) or moves to a preset position (configurable with some models)
Action on Loss of Power	Stays in place
Enclosure	Type 4 or 4X (depending on specific model). Models approved for use in Hazardous classified locations are also available—contact a Beck Sales or Application Engineer for details.

HART COMMUNICATION PROTOCOL

Modbus MEMBER

BECK®

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Rev. 7.4