Electric Actuator Technologies
Design Approaches

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Electric & Electronic Actuators
Site Considerations

Application Issues

- High ambient temperatures
- Particulate-laden atmosphere
- Shock and vibration

Electric Actuators

Design Approaches

• Electro-Mechanical Actuation

SMB Electric Actuator

L120 Electric Actuators

Electric Actuators

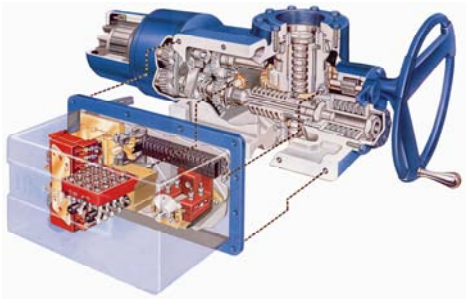
Design Approaches

•Electronic, Non-intrusive Actuation

MX Actuator

Electro-Mechanical Actuators

- Multi-turn output
- Double reduction gear set (Motor set & Worm set)
- Wide range of output speeds due to motor and gearing combinations
- Electro-mechanical torque control
- Electro-mechanical position control
- Broad range of thrust and torque ratings



Electro-Mechanical Actuators

Environmental Considerations

- Weatherproof
- Hazardous – explosion-proof, dust ignition proof
  Factory Mutual & CSA certifications to:
  Class I - Groups C & D - Divisions 1
  Class II, Groups E, F, G - Division 1

Vibration

- Ability to withstand severe shock and vibration
  Proven by independent tests, such as those for nuclear and US Navy installations

Electro-Mechanical Actuators

Temperature

- Suitable for line temperatures over 1,000º F
- Spring compensation option for stem growth or high speed
- Viton seals
- Teflon wiring
- High temperature lubricants

Electro-Mechanical Actuators

Electrical / Mechanical Features

- Cast iron or ductile iron gear housings
- Locking gearing
- Hammerblow effect
  Lost motion at the drive sleeve overcomes sticking valves by applying a “hammer blow” effect to the stem nut/valve stem interface
- Handwheel Operation
- Position Control (Limit Switch)
- Torque Control (Torque Switch)
- Position Indication – 0-10v or 4-20mA output

Electro-Mechanical Actuator
Controls

No Controls Unit – reversing starter mounted remotely from the actuator

Integral Reversing Controls – reversing starter mounted inside the actuator control compartment

•Electrical and mechanical options available
- ➢ Torque trending from torque switch output
- ➢ Valve disc position feedback
- ➢ On-actuator position indication

Electro-Mechanical Actuators
Position Control Switch
(Geared Limit Switch)

- Gear driven
  - reliable operation
  - 100% repeatable position control. In step at all times whether in manual or motor operation
- Infinite Set Positions from Full Open to Full Close
- 16 Electrical Contacts, 300v rated, to provide:
  - position control of the valve disc-to-seat interface
  - sequencing interface for related processes
  - valve position indication (open, closed, mid-travel)

Electro-Mechanical Actuators

Torque Control Switch

(Torque Switch)

- Provides torque control in open and close directions
- Adjustable to allow for changes in torque requirements due to valve seat wear or changes in operational requirements
- Provides Overload Protection
  Torque output limited to prevent excessive torque output
- Tight Valve Closure / Torque Seating
- Electrical contacts rated to 300v

Electro-Mechanical Actuators

Motor Designs

A wide range of motor options to meet varied installation requirements

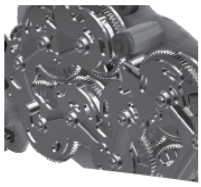
- AC Motors
  1 phase, 1-60-115v & 230v
  3 phase, 3-60-208v to 575v
- DC Motors
  125v or 250v

Motor design options include extended duty and/or extended dynamic torque

Electro-Mechanical Actuators
Summary

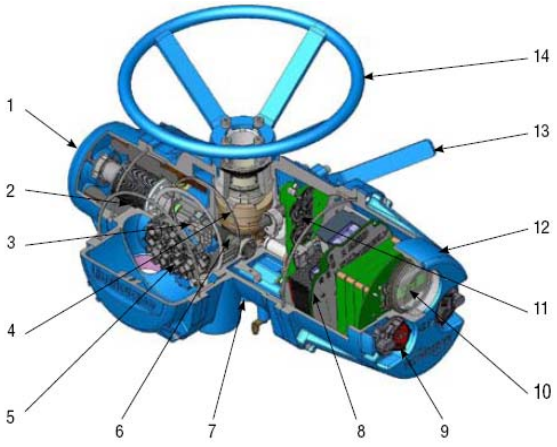
- Electro-Mechanical actuators are most often applied where:
  - the actuator controls are remotely located
  - the service conditions are the most severe
- Viton seals, lubricant, and wiring providing protection against high ambient temperatures
- Rugged design with proven long-term dependability

Electronic Non-Intrusive Actuation



Electronic Actuation

Smart, Non-intrusive



No.	Description
1	Three phase motor
2	Motor gear attachment
3	Plug-in connectors
4	Termination chamber
5	Terminal connection block
6	Gear set
7	Thrust base
8	Control chamber
9	Local control switches
10	Multi-lingual display
11	Absolute encoder
12	Cast aluminum housing
13	Declutch lever
14	Handwheel

Electronic Actuators

Position Sensing, Encoders

- Non-intrusive actuators typically use encoders to sense valve position
- Two basic types of encoders – incremental and absolute
- Incremental encoders count turns of drive sleeve digitally, but require some auxiliary power supply to maintain this information if main power is removed
- Absolute encoders count incrementally, but since they are absolute, can maintain position when power is isolated without auxiliary power supply

Electronic Actuators
Torque Sensing

MX Torque sensing is electronic technology…

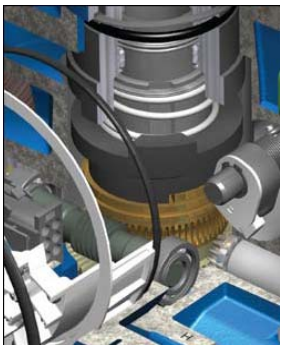
A microprocessor calculates output torque from motor speed, and voltage and temperature fluctuations. *The advantage is there are no moving parts that are subject to environmental conditions.*

Torque limit may be set from 40–100% of rating in 1% increments.

A boost circuit is included to prevent torque trip during initial valve unseating and in cold climates.

This torque boost feature can also be User configured to supply the maximum amount of torque the unit is capable of producing for aging or severe service valves.

A "Jammed Valve Protection" feature, with automatic retry sequence, is included to de-energize the motor if the output torque requirement exceeds boost torque.

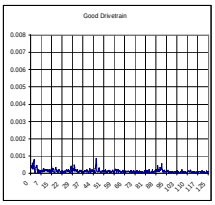


Electronic Actuators
Vibration and Seismic Tests

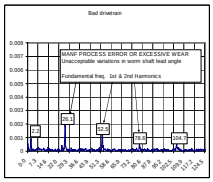
Test Levels	MX
Vibration Levels	IEC68-2-6; 5-200-5 HZ sweeps @ 0.75g in 3 axes; 2-35-2 Hz @ 1.0g in 3
Seismic Levels	5.0g from 3.5-35 HZ in 3 axes
Drop Test	ASTM D3332-88, method A

Electronic Actuators - Diagnostics

- B.I.S.T. features – redundant capabilities – if one of 18 optical devices fails (9 pairs), encoder can switch to another optical paired device and continue safe operation (up to 50% failure)
- An alarm will be noted that a "Hardware Failure" has occurred and should be resolved.
- Continued safe operation of the actuator is permissible until a second paired device fails.



- FDA = Frequency Domain Analysis, & captures torque, position , or speed values @ regular time intervals when the actuator is in motorized operation.
- The data collected is then calculated w/ a FFT (Fast Fourier Transform), which converts & stores the data as frequency.
- Frequency is used to determine a variation from normal operation which may indicate a premature component failure
- When compared w/ a baseline plot, collected @ EOL, a trend could indicate a valve or actuator problem



Electronic Actuators

Diagnostics

Bluetooth®

The MX now offers Bluetooth technology as optional, up to 10 meters. When used with Flowserve Limitorque's Windows CE based graphical interface Dashboard, diagnostic information can be transferred easily to a PDA, lap top computer or cell phone. In addition, new firmware can be uploaded and actuator configurations transferred from one device to any number of subsequent actuators.

Standard low power wireless communication path to the actuator enables monitoring and configuration of the unit via a Bluetooth equipped PC, PDA, Cell Phone, etc WITHOUT having to stand directly in front of the control head. FHSS (Frequency Hopping Spread Spectrum) allows a reliable communication link even in a "noisy" environment & 128 bit data encryption can be enabled to protect the privacy of the link. MX Dashboard configuration / diagnostics tools can use the Bluetooth link as a means for communicating with the actuator. Visible Blue LED in the controls LCD window signifies an active Bluetooth link to the actuator is established.

Electronic Actuators
Networks

Modbus ™

Interconnectivity options provide flexibility for interfacing with various customer control systems by utilizing proven and accepted open systems based communication architectures.

Network Options:
- Master Station II
- Foundation Fieldbus H1
- Profibus DP-V1
- Profibus PA
- Modbus
- DeviceNet
- FDT/DTM

Electronic Actuators
Networks

- Modbus
  - Increase in transmission rate up to 115.2 kbps
  - Dual network boards for component/line redundancy
- Foundation Fieldbus
  - PID functionality w/ adaptive self tuning algorithm
  - FDT/DTM

Electronic Actuators
Networks

- Profibus DP
  - Profibus DP/V2 will provide slave-to-slave communications using broadcast communication via "publisher" / "subscriber" method, as well as synchronization of all networked MXs to a system time with a deviation of less than a millisecond. This will enhance diagnostic reporting of faults, as well as the chronological sequencing of events.
  - Profisafe will provide communication to “Safety Hosts” while supporting up to SIL 3.
  - RedCom will provide a channel for redundant communications
  - Dual boards w/ independent connections for component/line redundancy
  - FDT/DTM

Electronic Actuators
Networks
FDT/DTM Technology

Device Type Manager (DTM) files that can be integrated in to any Field Device Tool (FDT) frame application that is coupled to an asset management suite. This allows protocol independent networking with instrument user interface in a standard software environment.

- The **DTM** is a software component that encapsulates all device-specific data, as well as provides functions for accessing device parameters, configuring and operating the devices, and diagnosing problems. It can be developed from GSD/DD files.

Electronic Actuators
Networks
FDT/DTM Technology

Device Type Manager (DTM) files that can be integrated in to any Field Device Tool (FDT) frame application that is coupled to an asset management suite. This allows protocol independent networking with instrument user interface in a standard software environment.

- The **FDT frame application** defines a set of interfaces between the hosting application and the DTMs. The application will contain the communication component (ComDTM) to interface the host system with the specific fieldbus communication (e.g., HART, PROFIBUS, FOUNDATION fieldbus, etc.). The FDT container initiates the DTM and enables interaction between the host and field device.

Electric & Electronic Actuators – Coker User Installations (partial listing)

Company	Actuator Brand
Motiva	SMB - NCU
Sonoco Phillip	MX
Shell	L120 BIC
Chevron	SMB - NCU
Exxon	L120 BIC
Lyondell - Citgo	L120 BIC
Chevron	L120/MX
Pemex - Mexico	MX
Lyondell	L120 BIC
Valero	L120 BIC
CVR Energy	SMB / L120
Conoco Phillips	L120 BIC
Petrobras – Brazil	L120 / MX w/ DDC
ENAP – Chile	MX
Motiva	L120 BIC
Valero	L120 BIC
NCRA	SMB / L120
BP / Amoco	L120 BIC
Pemex - Mexico	L120 BIC
Hovensa,	L120/UEC

Electronic Actuators
Summary

• Preferred for applications requiring:
- integrally mounted controls
- network capabilities
- advanced data acquisition