Introducing -
M-Mac Actuators Inc.

History

• 1990 - company formed to design & manufacture custom machinery and hydraulic systems

• Projects include automated ferry ramps, sub-sea pipeline manipulator, helicopter grapples, fibre-optic junctions, etc.

• 1999 - first M-Mac Electro-Hydraulic Actuator made

• 2002 - patents granted

• 2004 - two hundred actuators sold for use in diverse applications
M-Mac Electro-Hydraulic Actuators

Custom Linear Actuators
(4,400 - 32,400 lb thrust)

Rotary Actuators
(up to 800,000 lb.in torque)

Small Linear Actuators
(up to 3,000 lb thrust)

The M-Mac Electro-Hydraulic Linear Actuator

- Volume compensator
- Valve block
- Pump
- Electric motor
- Mounting clevis
- Hydraulic cylinder
MH20-12-C-1

For continuous modulation of a scrubber damper in a Bowater Pulp Mill, Alabama

Internally-mounted absolute magnetostrictive position sensor for closed-loop control

Head-mounted
7,800 lb force
10” stroke
1 inch/sec

MT25-C

Continuous modulation of flue-dampers at Kennecott Utah Power Plant
Slide 7

**MC25-10**

For automobile manufacture in Korea

- 12,200 lb force
- 10” stroke
- 1 inch/sec

Slide 8

**M40T**

*"Mighty - Mac"*

- 32,000 lb thrust
- Simulates earth-quake forces on buildings
- Instrumented for absolute position (Tempsonic sensor) and load-cell force measurement
- Continuous Duty Cycle
The M-Mac Rotary Actuators

Scotch-yoke 1/4 Turn Rotary Actuator

- High start- and end-torques, up to 400,000 lb.in torque at 1,500 psi
- Volume compensator
- Valve block
- Electric motor
- Hydraulic cylinder
- Scotch yoke mechanism
- Position sensor / indicator

M-Mac/Parker 3/4-Turn Rotary Actuator

- Double-cylinder rack-and-pinion design
- Up to 600,000 lb.in torque at 3,000 psi
- For modulating valves, ESD valves, flue dampers, etc.
The M-Mac Small Actuators

Lightweight aluminum construction

12 or 24 volts DC

Thrusts up to 3,000 lb

Direct replacement for screw actuators

Key Features

- Factory filled and hermetically sealed
  leak-free in any orientation – quick to install

- Self-contained - no separate power unit
  no pipes or fittings to install or to leak

- No solenoid or servo-valves
  simple and reliable

- Motor-Controlled Operation
  precise positioning and speed

- Load-lock on loss of power
  check valves hold load indefinitely and safely

- Quiet
  no gear train noise
**Value Proposition:**

**M-Mac vs HYDRAULIC**

- Fast & clean installation
- No leaks & no maintenance
- Same performance & life
- Same cost
- **Other advantages:**
  - High efficiency / low power draw
  - No solenoid valves
  - No hoses, pipes or fittings
  - No oil contamination of oxidation
  - Factory filled & sealed

**Value Proposition:**

**M-Mac vs PNEUMATIC**

- Better reliability
- Better performance (stiff action and higher force)
- Less cost
- **Other advantages:**
  - Lower energy draw
  - No piping
  - No airlines to freeze
  - Internal corrosion/jamming eliminated
  - Less noise
Slide 15

**Value Proposition:**

M-Mac vs SCREW ACTUATORS

- Twice the force density
- Five-to-ten times the life
- Same cost
- Other advantages:
  - Tougher (dirt, moisture, abuse, heat, shock)
  - Higher efficiency / lower power draw
  - Safer (load-lock by check valves)
  - Quieter

Slide 16

**Models Available**

<table>
<thead>
<tr>
<th>Model</th>
<th>Push Force (pounds)</th>
<th>Pull Force (pounds)</th>
<th>Strokes (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM15</td>
<td>3,000</td>
<td>2,500</td>
<td>4 to 12</td>
</tr>
<tr>
<td>M15</td>
<td>4,400</td>
<td>3,300</td>
<td>4 to 14</td>
</tr>
<tr>
<td>M20</td>
<td>7,800</td>
<td>5,700</td>
<td>4 to 20</td>
</tr>
<tr>
<td>M25</td>
<td>12,200</td>
<td>8,500</td>
<td>Up to 44</td>
</tr>
<tr>
<td>M30</td>
<td>17,600</td>
<td>11,600</td>
<td>Up to 44</td>
</tr>
<tr>
<td>M35</td>
<td>24,000</td>
<td>16,200</td>
<td>Up to 44</td>
</tr>
<tr>
<td>M40</td>
<td>31,400</td>
<td>23,500</td>
<td>Up to 44</td>
</tr>
</tbody>
</table>
Typical Applications

<table>
<thead>
<tr>
<th>Typical Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valve Actuators</strong></td>
</tr>
<tr>
<td>Feed water valves, attemperating</td>
</tr>
<tr>
<td>spray valves, emergency shut-down</td>
</tr>
<tr>
<td>valves, choke valves</td>
</tr>
<tr>
<td><strong>Process Control</strong></td>
</tr>
<tr>
<td>Damper drives, turbine governors,</td>
</tr>
<tr>
<td>air register drives, burner</td>
</tr>
<tr>
<td>shut-off dampers, igniter gun</td>
</tr>
<tr>
<td>drives, fuel atomizer drives)</td>
</tr>
<tr>
<td><strong>Manufacturing</strong></td>
</tr>
<tr>
<td>Robot arms, product-handling,</td>
</tr>
<tr>
<td>lift-tables, conveyor diverters,</td>
</tr>
<tr>
<td>etc.</td>
</tr>
<tr>
<td><strong>Patient Handling</strong></td>
</tr>
<tr>
<td>Hospital beds, operating tables,</td>
</tr>
<tr>
<td>airline seat actuators</td>
</tr>
<tr>
<td><strong>Test Equipment</strong></td>
</tr>
<tr>
<td>Building materials, product</td>
</tr>
<tr>
<td>testing</td>
</tr>
<tr>
<td><strong>Steering Systems</strong></td>
</tr>
<tr>
<td>Tractors, man-lifts, boats</td>
</tr>
<tr>
<td><strong>Military Equipment</strong></td>
</tr>
<tr>
<td>Tanks, aircraft launch systems</td>
</tr>
</tbody>
</table>

User List

John Deere
US Navy
US Air Force
Kimberley Clarke
US Postal Service
Kennecott Copper
University of California, Berkley
Blue Circle Cement
Saskatchewan Wheat Pool
Summary

M-Mac Actuators has:

- A technologically and economically advanced motion control product
- Patented technology
- A proven product - 4 years of field trials
- M-Mac can produce an EHA for your application

Questions?

Appendix

The following slides show common modes of actuator control followed by some general specifications.
Slide 21

**Modes of operation**

**MANUAL FIXED SPEED**

Actuator

Slide 22

**Modes of operation**

**MANUAL FIXED SPEED with FEEDBACK**

Position Sensor

e.g. Temposonic
Slide 23

**Modes of operation**

**INVERTER or VFD**

**MANUAL VARIABLE SPEED**

Slide 24

**Modes of operation**

**MANUAL VARIABLE SPEED with FEEDBACK**
Slide 25

Modes of operation

FULLY CLOSED LOOP POSITION and SPEED CONTROL.

INVERTER or VFD

PLC / S Series

2.314 "

Slide 26

Small Actuator Specification

- Weight: 1.5Kg
- Stroke: 200 mm
- Force Output: 2,600 N
- Speed: Zero to 14 mm/s
- Noise: 38 dBA
- Voltage: 24 volts DC
- Temperature: -55 C to 85 C, storage
- Creep: 1mm in 24 hours loaded
- Manual Override: lever operated valve
- Load Sensing: Pressure sensor/loadcell
- Position Sensing: Absolute
- Life: 1E6 cycles minimum
- Maintenance: Zero
- Operating Pressure: Adjustable
- Flammability: Customer defined
- Abuse loads: Customer defined
- Crash loads: Customer defined