The JR Linear Drive System

Technical Data Sheet TDS JR-1000
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1. INTRODUCTION

The JR Linear Drive System is a high-performance, digital controlled, pneumatically operated linear damper drive system suitable for most wall-fired boilers. JR Linear Drives are specifically designed to replace existing electrically operated linear drives. Take-out dimensions were selected to make the JR drive a quick and easy retrofit solution for most conventional electric linear drives. Unlike most pneumatically operated drives, the JR incorporates all the fail-in-place characteristics of electric drives without the drawbacks of limited duty cycles and low resistance to moderate ambient temperatures found in most utility power boiler applications.

2. APPLICATIONS

The JR drive is specifically designed to control the position of the air dampers that modulate the amount of secondary air to a pulverized coal burner as shown in the illustration below.

Most wall-fired boilers typically have burners where the fuel and combustion air are combined. In pulverized coal fired boilers the fuel is conveyed by the primary air. Primary air flow is determined by the pulverizer. Secondary air is introduced at the burner and its flow is determined by a sliding disk or sliding sleeve mechanism that is usually positioned by a linear actuator. Most linear actuators in use today are operated by an electric motor that drives a lead screw type mechanism. In past times these electrically operated drives were typically placed in one of three positions; light-off, full-load, and idle/cooling by setting hard-to-adjust travel switches. Frequent modulation of the electric drives usually resulted in premature failure due to limited duty cycle design. With the JR Linear Drive System, users are free to modulate the drive position as often as required to maintain set point conditions and are not limited to a few pre-settable travel stop locations.
3. FEATURES AND BENEFITS

The JR Linear Drive System has many advanced features that will enhance the operation of any air damper, and reduce or eliminate frequent and costly maintenance while improving overall performance.

- **Unlimited Duty Cycle**
  Which means the JR drive can be operated as frequently as necessary without fear of component failure or motor burn-out?

- **High Temperature Construction**
  The JR drive with its 300°F rated Power Cylinder is designed for long-life in the high ambient temperatures typically found around utility boilers. This will lower the overall cost-of ownership and increase up-time.

- **Very-High Performance Positioning**
  The Power Cylinder is capable of being positioned to within +/- 0.5% which means better and more repeatable damper positioning to aid in overall operation and to help lower NOx.

- **Split-Architecture Design**
  All control components may be located up to 100 feet away from the Power Cylinder and boiler front allowing for easier access while placing all electronics in a more favorable environment.

- **Local / Remote Selector Switch**
  This feature allows for complete drive operation from the firing aisle.

- **Fewer Moving Parts**
  Fewer moving parts and no “Deadband Robbing” gears and couplings means less maintenance and much improved positioning performance

- **Completely Field Repairable**
  All major components are modular and can be easily repaired or replaced without having to send the drive back to the factory, and in most cases without having to remove the drive to a service area. This results in lowering the cost of ownership and increasing uptime

The JR Linear Drive System improves overall performance, is easy to install and set-up, and simple to maintain because of the thoughtful design approach, simplicity of construction, and careful selection of all components.
The JR Linear Drive System consists of two principal components.

- The JR Linear Power Cylinder with a self-contained patented Linear Position Transducer.
- The DPC-777 Digital Position Controller

The JR Linear Power Cylinder Actuator

![JR Linear Power Cylinder](image)

The JR linear cylinder actuator is a highly engineered linear air cylinder designed to provide high performance and extended life in the harsh environments found in and around the burners on wall-fired utility boilers. Materials of construction have been selected to resist the corrosion and abrasion from long-term exposure to coal dust and fly ash, and to provide long life. JR Linear Power Cylinders are available in sizes and thrust ratings to meet every Secondary Air application.

<table>
<thead>
<tr>
<th>Piston Size</th>
<th>Piston Strokes</th>
<th>Developed Thrust @ 100 psig</th>
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</thead>
<tbody>
<tr>
<td>4 in. dia.</td>
<td>6 in, 12 in, &amp; 18 in</td>
<td>1178 lbs.</td>
</tr>
<tr>
<td>5 in. dia.</td>
<td>6 in, 12 in, &amp; 18 in</td>
<td>1885 lbs.</td>
</tr>
</tbody>
</table>

Note: Refer to page 00 for envelope dimensions for all Power Cylinders.

The DPC-777 Digital Position Controller

![DPC-777 Digital Position Controller](image)

The Type K DPC-777 is a high-performance digital damper drive position controller that has many advanced features that will improve the operation of any damper control system. The enclosure is non-metallic, NEMA 4X design.
4. Operation

Operation of the JR Power Cylinder

Basic Power Cylinder and Linear Position Transducer Arrangement

The anodized extruded aluminum cylinder with hard chrome plated piston rod is available in 4 inch and 5 inch diameter piston sizes and 6 inch, 12 inch, and 18 inch stroke lengths. Standard seals are BUNA-N, High Temp (300ºF) seals are Viton. The unique Twin-seal rod gland assembly prevents fly ash and coal dust from entering the cylinder. The linear position transducer (LPT) is mounted within the cylinder and connected to the DPC-777 controller enclosure by a 3-conductor cable. The cylinder can be located up to 100 ft. from the DPC-777 controller. The cylinder can be configured to extend or retract on an increasing 4-20 mA signal to the DPC-777.

The DPC-777 Digital Position Controller

The DPC-777 Digital Position Controller consists of five principal components.

- The Digital Control Module (DCM)
- The digital/pneumatic interface module (4-way 3-position proportional valve), installed inside the remote mounted control enclosure.
- Assorted switches terminal strip, bulkhead fittings (air connections), and glands (electrical connections).
- Either 25 ft / or 100 ft of shielded 3-wire connecting cable w/ quick disconnect connector at the Power Cylinder end.
- NEMA 4X Fiberglass enclosure rated –20 to +120 ° F*

All components are readily accessible and easily maintained by the user.

Note: Optional enclosure materials of construction are available, consult the factory
The principal component of the Digital Position Controller is the Digital Control Module (DCM). All operations, with the exception of setting the stroke speed are performed on the DCM by manipulating the (3) push buttons. No additional calibration equipment is necessary.

**DPC-777 Enclosure Door Push Buttons**

The door of the DPC-777 is equipped as standard with a **RESET** push button. The purpose of this push button is to interrupt line power to the DPC-777 to allow the resetting of the digital control module should a fault occur.

As an optional feature the DPC-777 may be furnished with two selector switches marked **REMOTE / LOCAL** and **CLOSE / OPEN**. These switches allow for the complete operation of the JR Linear Drive in the field location. Placing the **REMOTE / LOCAL** switch in the local position interrupts the 4-20 mA input signal from the process control system and permits operation of the **CLOSE / OPEN** selector. Holding the **CLOSE / OPEN** selector in either the close or open position will cause the drive to respond accordingly. When pressure is removed from the **CLOSE / OPEN** selector switch it will return to the center off position.

**Digital Control Module (DCM)**

![Operational Push Buttons](image)
OVERVIEW OF DCM

The simple three-button control on the digital circuit module is used to configure all parameters the unit needs for a wide variety of applications, and allows the open and closed positions to be easily set for direct or reverse operation without any re-wiring. The input signal is 4-20 mA DC.

Various option modules are available and are easily plugged into the unit, providing for position feedback and travel/alarm switches.

4-20 mA loop powered, isolated position feedback signal
4-20 mA device powered, non-isolated position feedback signal with (2) two adjustable position relay contacts, and (1) fault relay contact. All relay contacts are rated 0.5 A @ 120 VAC, 1.0 A @ 24 VDC.

Operational Features

- Position control to +/- 0.5% or better on the Type K JR Linear Drive.
- Adaptive Control continuously adjusts for load and actuator conditions and eliminates calibration procedures and auto-cal operations.
- Three-button control provides easy setup
- Polarity detection allows direct or reverse acting operation without rewiring
- Stall detection can prevent damage to mechanical equipment.
- Operating temperature range of 32 to 120°F (0 to 50ºC)
- Fail-in-Place or Fail Open or Closed on loss of signal.
- Fail-in-Place on loss of air or power supply.
- All components are easily user maintained in the field.

DCM Operation

The Digital Control Module (DCM) is designed to operate a proportional valve with up to 5.0 Amp running current. The unit is easily mounted with two screws and is equipped with removable screw terminals that provide for easy field wiring.

The simple three-button control (MODE, ▲, and ▼) allows the user to perform a complete set-up from the unit itself without the need for any instrumentation. The adaptive control feature of the DCM eliminates the need for any calibration steps. In the simplest application, only the open and closed positions need to be set, the DCM automatically and continuously sets all other parameters when placed in the AUTO mode.
Mode

The MODE button is used to select the desired function of operation. When the MODE button is pressed, the unit will switch to the next function and the appropriate LED indicator will turn on to let the user know which function is selected. Each of the modes is described in more detail in the following sections.

Adjust Up (▲) and Adjust Down (▼)

The Adjust Up (▲) and Adjust Down (▼) buttons are used to adjust the setting of any given function. When a function is selected by the MODE button, adjust buttons will affect that function only. Note, that the AUTO mode does not have any adjustable settings, and therefore, the adjust up (▲) and adjust down (▼) have no effect.

AUTO

The AUTO function is the normal mode of operation for the DCM; all other functions are used to set up the unit. While in AUTO the unit is controlled by the Demand (input) signal. When the unit is not in the AUTO mode, all external controls described below will be disabled.

MANUAL / FB POT CAL

The MANUAL / FB POT CAL function allows manual operation of the drive by using the adjust buttons (▲ and ▼) without affecting any other settings within the DCM.

*Note: The FB Pot Cal feature is not used when controlling a Power Cylinder.*

CLOSE

The CLOSE function is used to set the desired closed position. When the CLOSE function is selected, the adjust buttons are used to set the drive to the required position, and upon pressing the MODE button (to select the function OPEN), the DCM will retain the setting as the defined closed position.

OPEN

The OPEN function works the same way as the CLOSE function with the exception that the adjust buttons are used to set the desired open position. As with the CLOSE function, on selecting the OPEN function, the drive will move to the previously set open position.

AUX CLOSE OUTPUT

The AUX CLOSE OUTPUT function is used to set an optional relay output contact closure that is associated with the closed position — an optional relay module is required to use this feature.

AUX OPEN OUTPUT

The AUX OPEN OUTPUT function is used to set an optional relay output contact closure that is associated with the open position — an optional relay module is required to use this feature.

COMMAND TYPE
The **COMMAND TYPE** function is used to configure the Demand (input) signal for 4-20 mA so as to match the type of command signal being used. No other Demand (input) signal types are currently in use.

**LOSS OF COMMAND**

When using 4-20 mA, input for the Demand signal, the DCM will detect when the Demand signal is lost or out of range. A loss of command condition is detected whenever the Demand (input) is disconnected, becomes less than 3.0mA, or the Demand (input) signal becomes greater than 22 mA. If the DCM detects a loss of command signal, the Fault indicator will flash and the drive will be moved to one of the three preset positions.

**FAULT / AUX POSITION OUT CAL**

When the **FAULT** indicator flashes, a fault condition has been detected. The **POSITION OUT CAL** function is used to calibrate an optional feedback transmitter output. An optional 4-20 mA position feedback module is required to use this feature.

**FAULT INDICATOR**

The DCM detects various fault conditions that prohibit the unit from controlling the drive. When any of these conditions are detected, the fault indicator will flash, and the outputs to the Power Cylinder are turned off until all fault conditions are corrected. If an appropriate relay option is installed, the fault relay contact closure will open.

*Note: Refer to the JR Installation and Operating Manual for a complete description of the DCM operation.*

### 5. Specifications

**JR Power Cylinder**

Materials of Construction:
- Power Cylinder body: extruded aluminum hard anodized for corrosion resistance
- Power Cylinder piston & endcaps: high strength aluminum alloy
- Piston rod: hard chrome plated and polished carbon steel
- Fasteners & Tie-rods: zinc plated steel
- Rod Seal & Rod Wiper: carboxylated nitrile (Std. Temp), fluorocarbon (high temp)

Ratings:
- Temperature: -20º to 150 ºF (std. temp), -20 to 300 ºF (high temp)
- Pressure: 250 psig max.

Mounting Arrangement: Piston and Cylinder end treatments to suit application.

**LPT Specifications**

- Fluids: Compressed Instrument Air
- Repeatability: 0.001" (dependent on stroke)
- Life Expectancy: 500 Million inches travel
- Max. Stroke: 18"
- Pressure Rating: 5000 psig
- Impedance: > 500K ohms
- Temperature Rating: 300° F
- Resistance: 1000 ohms/inch +/- 20%
DPC-777 Digital Controller Specifications

Power Requirements
DCM-777S: 117VAC +/- 10%, 50/60 Hz, 15VA
DCM-777L: 24 VAC +/- 10%, 50/60 Hz.

Demand Input Signal
Input Impedance: 251 ohms +/- 1% (4-20 mA)
Loss of Command threshold: < 3mA or > 22mA (4-20 mA)

Feedback Signal Input
Input voltage: 0 to 2.5 VDC
External LRT: 1K ohm/inch of travel

Digital Circuit Module
Operating Temperature Range: 32 to 140°F (0 to 60°C)
Storage Temperature Range: -40 to 185°F (-40 to 85°C)
Relative Humidity Range: 0 to 90% (non-condensing)

Digital/Pneumatic Interface Module
Operating Temperature Range: 32 to 120°F (0 to 60°C)

Control Feedback LRT
Operating Temperature Range: -40 to +302°F (-40 to 150°C)

Enclosure
Construction meets NEMA / EEMAC Type 4, 4X Specifications.
UL 508 and UL 50 listed, Type 1, 2, 3, 3R, 4, 4R.
CSA certified file LR 89590-1.
Enclosure flammability rating per UL 508.
Joint Industrial Council (JIC) enclosure sizing.
6. Drawings

JR Power Cylinders

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**5 INCH CYLINDER**
12 INCH STROKE

**4 INCH CYLINDER**
12 INCH STROKE

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<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>STROKE</th>
<th>PIN TO PIN (OEM)</th>
<th>PIN TO PIN (RETRO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 INCH</td>
<td>6</td>
<td>17.82</td>
<td>22.22</td>
</tr>
<tr>
<td>4 INCH</td>
<td>12</td>
<td>23.82</td>
<td>28.22</td>
</tr>
<tr>
<td>4 INCH</td>
<td>18</td>
<td>29.82</td>
<td>32.22</td>
</tr>
<tr>
<td>5 INCH</td>
<td>6</td>
<td>17.82</td>
<td>22.22</td>
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<tr>
<td>5 INCH</td>
<td>12</td>
<td>23.82</td>
<td>28.22</td>
</tr>
<tr>
<td>5 INCH</td>
<td>18</td>
<td>29.82</td>
<td>34.22</td>
</tr>
</tbody>
</table>
JR Power Cylinder compared to a Jordan LA-2400 Series

JORDAN 2400 SERIES
WITH 12" STROKE
DRIVE IN DASHED LINES

28.61
(LF 2400)

28.216

TYPE K 5 X 12 LINEAR DRIVE

2.75

2.75

8.66

6.19
JR Power Cylinder compared to a Jordan LA-2500 Series
DPC-777 Position Controller

 MATERIAL: 12 X 10 ULTRALINE CLEAR COVER

NOTES:
1. ENCLOSURE IS MOLDED FIBERGLASS POLYESTER MATERIAL.
2. REMOVABLE HINGE COVER WITH 316 S.S. HINGE PIN.
3. WATERTIGHT & DUST TIGHT COVER SEAL.

MATERIAL: AMU1206 BOX (FIBERGLASS)
Power Cylinder Construction Specifications

1. Bore Diameter inches & Thrust lbs. at 100 psig (6.90 bar) air supply pressure
   - 4 inches (101.6mm), 1178 lbs. (535 kg)
   - 5 inches (127mm), 1885 lbs. (855 kg)

   Available air supply pressure
   __ psig / __ bar Max.
   __ psig / __ bar Min.

Digital Position Controller Specifications

7. Position Controller
   - D1 DPC-777 Digital Position Controller
     w/ "Reset" button.
   - D2 DPC-777 Digital Position Controller
     w/ "Reset" button, "Local/Remote" and "Open/Close" switches.

Mounting Arrangement

A. Front & Rear Clevis Mounting (B & W style Jordan)
B. B & W OEM Special

Replaces:
New OEM installation

Materials of Construction

1. Anodized aluminum with hard chrome-plated steel piston rod. and 304 SS hardware

Temperature Rating

1. -20 to +150 deg. F. (-28 to + 66 deg. C)
2. -20 to +300 deg. F. (-28 to +149 deg. C)

Notes

Clevis mount, pin to pin length when fully retracted: _______ inches (mm)

Type K Dwg. No.: _________________________

Approx. weight: _________________________ lbs. (Kg)

Enclosure Rating

1. NEMA 4X, IP66, watertight & dusttight
   -20 to +120 deg. F. (-28 to + 49 deg. C)
   Note: no agency electrical approvals

2. Painted metal NEMA 4, IP66, watertight & dusttight
   -20 to +120 deg. F. (-28 to + 49 deg. C)
   Note: no agency electrical approvals

Power Cylinder to DPC-777 Connecting Cable

1. 25 ft. (7.62 m) w/ multi-pin connector/dressed leads
2. 100 ft. (30.48 m) w/ multi-pin connector/dressed leads

Cable rated for -20 to +300 deg. F. (-28 to + 149 deg. C)

Notes on the Air Filter Requirements

1. No filter required buyer assumes liability of failure due to under spec. air quality.

2. Combo Particulate & Coalescing Air Filters suggested use is (1) filter package for every (4 to 6) DPC-777s
   (this feature is required for the 3-year warranty)

SELECTED FIGURE NO: JR -

Code Item: 1 2 3 4 5 6 7 8 9 10
Your Representative is:

Controls International, Inc.
10410 Vista Park Road
Dallas, Texas 75238
Main: (214) 343-9980
Fax: (214) 343-2658

www.cii-holdings.com

Our drives are proudly made in Dallas Texas, USA

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**Pedestal Mount**
- Direct ‘Drop-In’ Design matches existing drive
- Re-use existing link rod and clevis
- Highly accurate & responsive
- Simple maintenance-free operation

**Direct Mount**
- Mounts directly to boiler wall of damper frame
- ‘No Play’ connection to damper shaft
- Highly accurate & responsive
- Simple maintenance-free operation

**LX Linear Drive**
- The Ultimate Rod Gland Cleaning System
- 1.5” to 24” Bore / Any Practical Stroke
- Exact Retrofit to match existing drive
- O/C or Modulating Service

**Valve Automation**
- Automate butterfly, ball and plug valves
- Simple one-moving part design
- Retrofit linkage available with drive
- Complete range of O/C & Modulating controls

**JR Linear Drive**
- Wall-Fired boiler secondary air control
- Precise ‘Drop-In’ replacement for electric drives
- Precise modulating control
- Remote-mount digital controller

**Ash Hopper**
- High-Cycle Ash Hopper solution
- Replace unreliable diaphragm drums or pistons
- Totally-enclosed, maintenance-free design
- Rated for 300 Degrees F

**CT Series**
- T-Fired boiler Secondary Air Control
- Trunnion-mount pivot style design
- For High-Temperature and Harsh Environments
- Precise Modulating Control

**Controls**
- S-800 Digital “Smart” & C-400 Conventional Positioners
- DPC-777 Remote Mount Digital Positioners

**Accessories**
- Windbox Bearing Upgrade, air filters
- 950 Series Loading station, connecting rod linkage