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Rev. 3

ZP200 Series Product Manual

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Electromechanical Positioning Systems

Important User Information



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• *For assistance contact:*
• Parker Hannifin Corporation
• 1140 Sandy Hill Road
• Irwin, PA 15642
• Phone: 724/861-8200
• 800/245-6903
• Fax: 724/861-3330
• E-mail: ddlcat@parker.com
• Web site: www.parkermotion.com
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ZP200 Series Product Manual

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Revision Notes

Rev 2 – 10/17/03 - Modified specifications and configurable per the precision and standard grade re-release. Corrected adapter plate thickness.

Rev 3 – 11/17/04 – Modified Limit & Home Sensors section to include new 4 wire sensor. Changed all logos to Parker only. Changed web address to www.parkermotion.com and removed division name from company address.



Chapter 1 - Introduction

Product Description

ZP200 Positioner

The ZP200 Z axis lift table is a stable support platform which provides precise vertical translation and positioning, while maintaining X-Y integrity. Recirculating square rail bearings are incorporated into a unique variation of “wedge” mechanics to enable reliable high dynamic performance without the potential loss of travel encountered with crossed roller bearings. The ZP200 is compatible with XR and LXR tables for multi-axis systems, and it can be utilized as the system base axis or top axis to fit the motion requirements of the application. Standard mounting holes and dowel pin holes accommodate repeatable mounting.

Unpacking



Unpacking

Carefully remove the positioner from the shipping crate and inspect the unit for any evidence of shipping damage. Report any damage immediately to your local authorized distributor. Please save the shipping crate for damage inspection or future transportation.

Incorrect handling of the positioner may adversely affect the performance of the unit in its application. Please observe the following guidelines for handling and mounting of your new positioner.

- DO NOT allow the positioner to drop onto the mounting surface. Dropping the positioner can generate impact loads that may result in flat spots on bearing surfaces or misalignment of drive components.
- DO NOT drill holes into the positioner. Drilling holes into the positioner can generate particles and machining forces that may effect the operation of the positioner. Parker Hannifin Corporation will drill holes if necessary; contact your local authorized distributor.
- DO NOT subject the unit to impact loads such as hammering, riveting, etc. Impacts loads generated by hammering or riveting may result in flat spots on bearing surfaces or misalignment of drive components.
- DO NOT submerge the positioner in liquids.
- DO NOT disassemble positioner. Unauthorized adjustments may alter the positioner's specifications and void the product warranty.

Return Information

Returns

All returns must reference a "Return Material Authorization", (RMA), number. Please call your local authorized distributor or Parker Hannifin Corporation Customer Service Department at 800-245-6903 to obtain a "RMA" number. See Parker Hannifin Corporation Catalog #8080/USA, page D34, for additional information on returns and warranty.

Repair Information

Out-of-Warranty Repair

Our Customer Service Department repairs Out-of-Warranty products. All returns must reference a "RMA" number. Please call your local authorized distributor or Parker Hannifin Corporation Customer Service Department at 800-245-6903 to obtain a "RMA" number. You will be notified of any cost prior to making the repair.

Warnings and Precautions



Vertical Operation

Depending upon your load and ballscrew selection the carriage and load may 'backdrive' in power loss situations potentially causing product damage or personal injury.



Strain Relieve Electrical Components

All electrical components (such as brakes, encoders, and limit/home switches) must be strain relieved. Failure to strain relieve electrical wires or cables may result in component failure and/or possible personal injury.

Specification Conditions and Conversions

Specifications are Temperature Dependent

Catalog Specifications are obtained and measured at 20 Degrees C. Specifications at any other temperature may *deviate* from catalog specifications. Minimum to Maximum continuous operating *temperature range* (with NO guarantee of any specification except motion) of a standard unit before failure is 5 - 70 Degrees C. Certain components can be eliminated or substituted to improve operation at these temperatures. Positioners with low temperature or high temperature components will be handled as specials, contact your local distributor.

Specifications are Mounting Surface Dependent

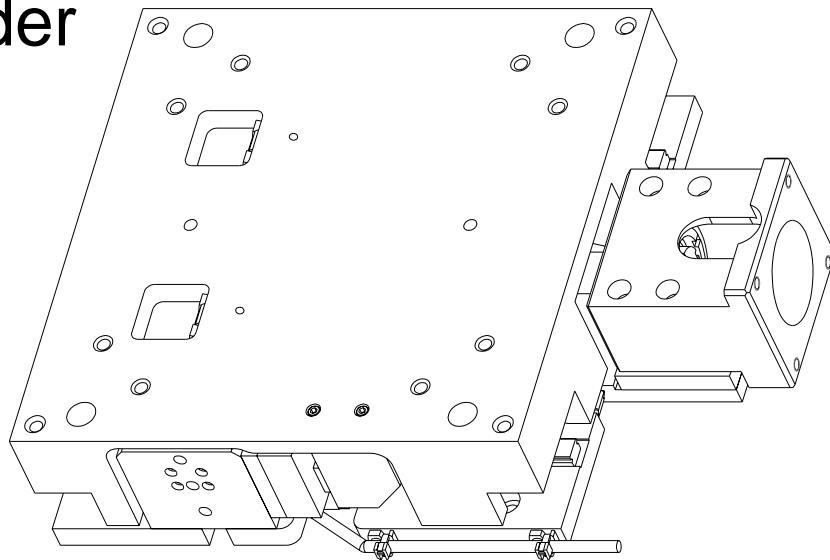
Catalog Specifications are obtained and measured when the positioner is *fully supported, bolted down* (to eliminate any extrusion deviation), and is mounted to a work surface that has a *maximum flatness error of 0.013mm/300mm (0.0005"/ft)*.

Specifications are Point of Measurement Dependent

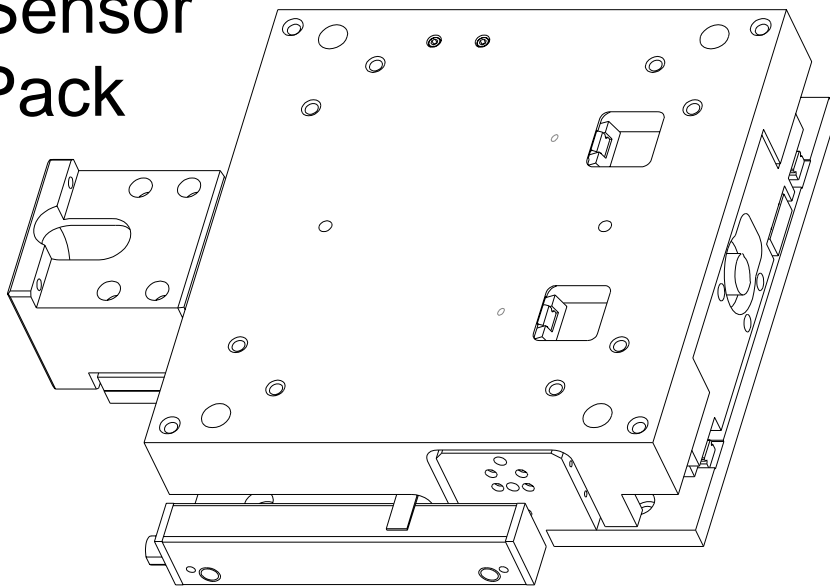
Catalog Specifications and Specifications in this manual are measured in the center of the carriage, 37.5mm above the carriage surface. All measurements taken at any other location may deviate from these values.

Component Configurations

Encoder



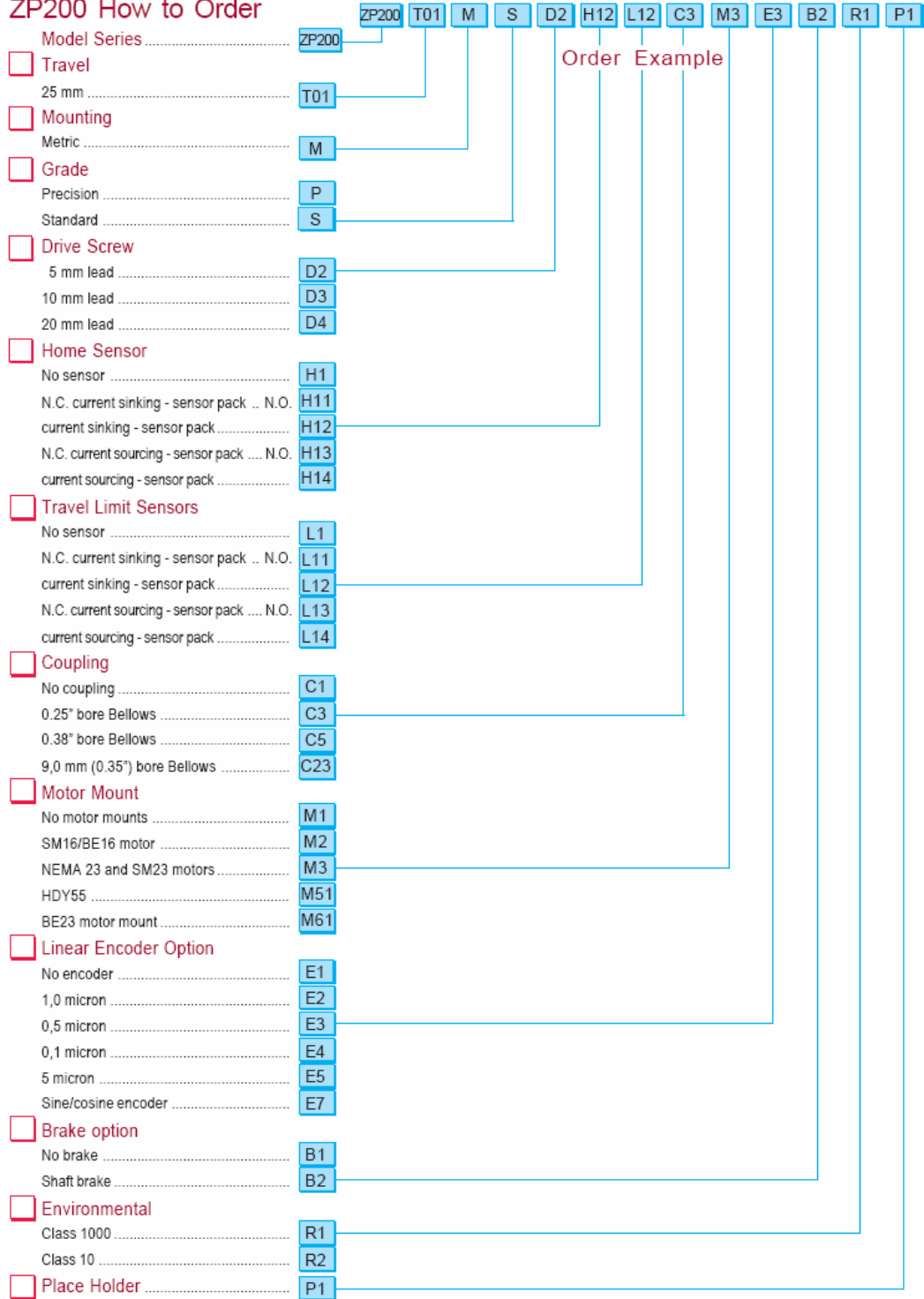
Sensor Pack



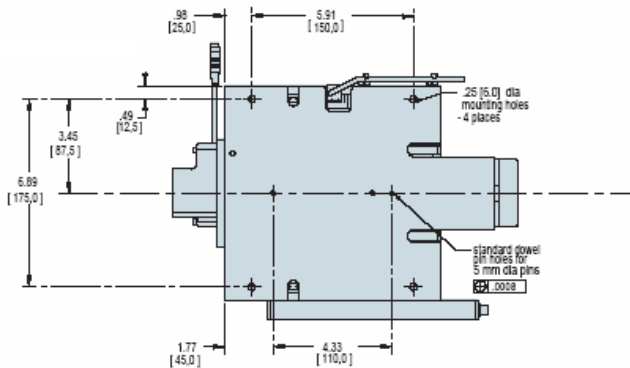
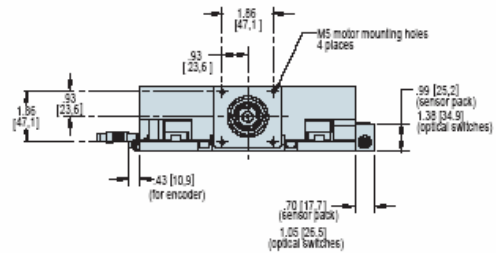
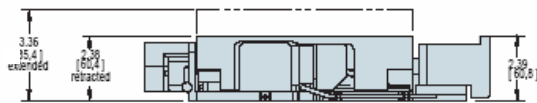
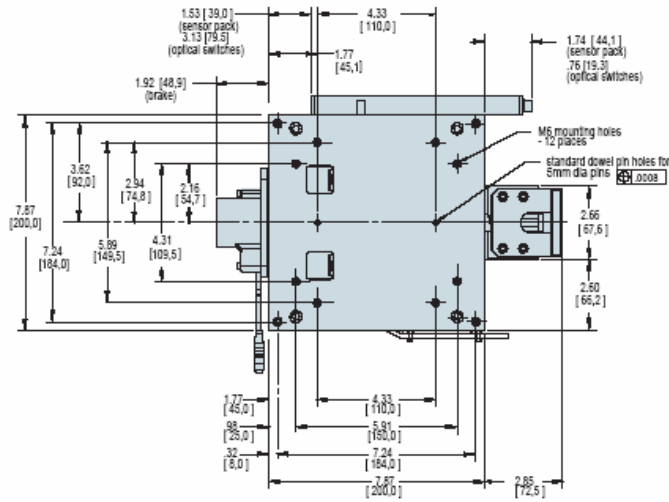
Chapter 2 – ZP200 Series Table Specifications

Order Number Nomenclature

ZP200 How to Order



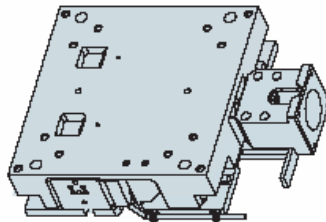
Dimensional Drawings



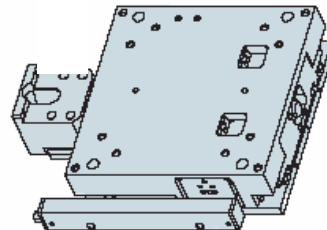
100-9274-01 XR Adapter Plate
A multi-axis adapter plate is available to mount the ZP200 to an XR/LXR table or, mount an XR/LXR table to the ZP200. This plate is 9.53 mm thick and includes standard dowel pin holes for repeatable alignment.

| | ZP200 as Base | ZP200 as Top Axis |
|------------|---------------|-------------------|
| 404XR | Yes | n/a* |
| 404LXR | Yes | n/a* |
| 406XR | Yes | Yes |
| 406LXR | Yes | Yes |
| 206 Rotary | Yes | n/a* |

*Not recommended - consult factory.



Encoder



Sensor Pack

General Table Specifications

| | Precision | Standard |
|---|-----------------------|---|
| Travel (Z-axis) | 25 mm(limit to limit) | 25 mm(limit to limit) |
| Positional Accuracy | | |
| with no encoder ^{1,2,7} | 8 µm | 20 µm |
| with linear encoder ^{3,6,7} | 8 µm | n/a |
| Positional Repeatability | | |
| with no encoder ^{1,7} | ± 3 µm | ± 10 µm |
| with 1.0 µm linear encoder ^{6,7} | ± 5 µm | n/a |
| with 0.5 µm linear encoder ^{6,7} | ± 4 µm | n/a |
| with 0.1 µm linear encoder ^{6,7} | ± 3 µm | n/a |
| Lift Lead Ratio ⁴ | | |
| 5 mm lead ballscrew drive | | 1.8199 mm/rev |
| 10 mm lead ballscrew drive | | 3.6397 mm/rev |
| 20 mm lead ballscrew drive | | 7.2794 mm/rev |
| Lift Velocity | | |
| 5 mm lead ballscrew drive | | 110 mm/sec |
| 10 mm lead ballscrew drive | | 220 mm/sec |
| 20 mm lead ballscrew drive | | 440 mm/sec |
| Load Capacity (normal) | 15 kg | 75 kg |
| Duty Cycle | | 100% |
| Max Acceleration | | 7.2 m/sec ² |
| Efficiency | | 90% |
| Max Breakaway Torque ⁵ | | 0.15 Nm |
| Max Running Torque ⁵ | | 0.13 Nm |
| Linear Bearing – Coeff. Of Friction | | 0.01 |
| Ballscrew Diameter | | 16 mm |
| Unit Weight | | 5.82 kg |
| Top Plate Weight | | 2.25 kg |
| Pitch ⁷ | ± 15 Arc Sec. | ± 45 Arc Sec. |
| Roll | ± 15 Arc Sec. | ± 25 Arc Sec. |
| Input Inertia | | |
| 5 mm lead ballscrew drive | | 2.32x10 ⁻⁵ Kg-m ² |
| 10 mm lead ballscrew drive | | 2.51x10 ⁻⁵ Kg-m ² |
| 20 mm lead ballscrew drive | | 3.12x10 ⁻⁵ Kg-m ² |

1 Measured 38mm directly above the true center of the top mounting surface.

2 Measured using calibrated lead value (provided).

3 Slope correction value provided

4 Lift per 1 motor shaft revolution. Lift lead listed is nominal. All units are provided with calibrated lead value.

5 Torque ratings are measured with unit unloaded, traveling upward.

6 Measured directly over encoder on outer edge.

7 Measured with 15 kg load for precision grade.

ZP200 Series Technical Data

The useful life of a linear table at full catalog specifications is dependent on the forces acting upon it. These forces include both static components resulting from payload weight, and dynamic components due to acceleration/deceleration of the load. In multi-axes applications, the primary positioner at the bottom of the stack usually establishes the load limits for the combined axes. When determining load/life, it is critical to include the weight of all positioning elements that contribute to the load supported by the primary axis. The life/load charts are used to establish the table life relative to the applied loads.

Life with Compression Load

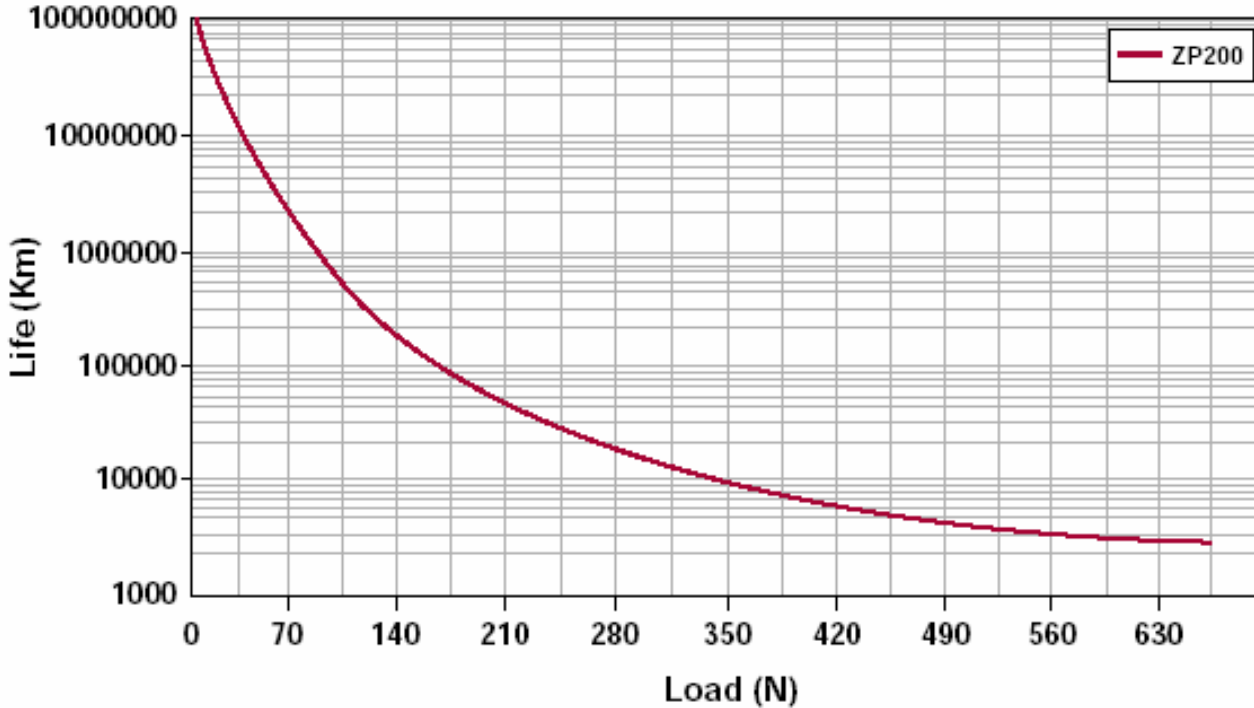


Table Life/Load Chart
Compression (normal load)

The graphs provide a preliminary evaluation of the support bearing life/load characteristics. The curves show the life/load relationship when the applied load is centered on the carriage, normal (perpendicular) to the carriage mounting surface.

Chapter 3 - Component Specifications

Linear Encoders

| Description | Specification |
|--|---|
| Input Power | 5 VDC +/- 5% 150mA |
| Output (Incremental) | Square wave differential line driver (EIA RS422) 2 channels A and B in quadrature (90) phase shift. |
| Output (Analog) | 2 Channels V1 and V2 differential sinusoids in quadrature (20 μ m pitch) 90o phase shifted. |
| Reference (Z channel) – see below for additional information | Synchronized pulse, duration equal to one resolution bit. Repeatability of position is unidirectional moving toward non-motor end. |
| Maximum Speed | 1.0 micron resolution = 3.0 meters/sec 0.5 micron resolution = 1.5 meters/sec 0.1 micron resolution = 0.3 meters/sec Analog = 3.0 meters/sec |

Z-Channel Position Reference

The Z channel is an output on the encoder. Many servo controllers support this input. The Z channel on the ZP200 is located at mid travel. The Z channel is a unidirectional device. This means that the final homing direction must occur in one direction. The ZP200 is set so that the final home direction is to be toward the non-motor end of the table. The repeatability of the Z channel is equal to +/- 2 resolution counts of the encoder (except for 0.1 micron scales which have a repeatability of +/-1 microns). Thus the repeatability of the “Z” channel equals:

| Encoder Resolution | Z Channel Repeatability |
|--------------------|-------------------------------|
| 1 micron | +/- 2 micron |
| 0.5 micron | +/- 1 micron |
| 0.1 micron | +/- 1 micron |
| Analog | Dependent on user electronics |

NOTE: Home repeatability is also very dependent on controller input speed and homing algorithms. The above repeatability does not include possible controller tolerance. Additionally, to achieve the highest repeatability the final homing speed must be slow. Slower final speed usually results in higher repeatability.

NOTE: The “Z” channel output is only one resolution count wide. Thus the *on-time* may be very brief. Due to this some controllers may have difficulty reading the signal. If you are experiencing the positioner not finding the “Z” channel during homing, try reducing final homing speed; also refer to your controller manual for frequency rates of the “Z” channel input.

Linear Encoder Speed Limit

The linear encoder has speed limits relative to encoder resolution; these limits are listed below:

| Encoder Resolution | Maximum Velocity (2) | Required Post Quadrature Input Bandwidth (1) |
|--------------------|----------------------|--|
| 1 micron | 3 meters/second | 6.7 Mhz |
| 0.5 micron | 1.5 meters/second | 6.7 Mhz |
| 0.1 micron | 0.3 meters/second | 10 Mhz |

- (1) This is the bandwidth frequency that the amplifier or servo control input should have to operate properly with the encoder output at maximum speeds. This frequency is post-quadrature, to determine pre-quadrature divide above values by 4. Above frequencies include a safety factor for encoder tolerances and line losses.
- (2) Maximum encoder speed may exceed maximum speed of positioner – See page 10, General Table Specifications, for maximum screw speed.

Linear Encoder Wiring Diagram

Termination: Flying Leads

| Function | Signal Name | Wire Color |
|--------------------|--------------|--|
| Power | +5V | Brown |
| | 0V | White |
| Incremental Signal | A+ | Green |
| | A- | Yellow |
| | B+ | Blue |
| | B- | Red |
| Reference | Z+ | Pink |
| | Z- | Grey |
| Set-up Signal | X | Clear |
| Inner Shield | Inner Shield | Bare (Connect to White Lead - 0V Ground) |
| Outer Shield | Outer Shield | Bare (Connect to Earth Ground) |

Couplings

Coupling Grade (Style): Precision Grade (Bellows)

| Catalog Coupling Code | Bore Diameter (Motor Side) | Outside Diameter (mm) | Length (mm) | Rated Torque (Nm) | Torsional Windup (Nm/Rad) | Misalignment Specifications | | |
|-----------------------|----------------------------|-----------------------|-------------|-------------------|---------------------------|-----------------------------|------------|----------|
| | | | | | | Lateral (mm) | Axial (mm) | Angular |
| C3 | 0.250" | 25 | 32 | 2 | 1530 | +/- 0.1 | +/- 0.3 | +/- 1.2° |
| C5 | 0.375" | 25 | 32 | 2 | 1530 | +/- 0.1 | +/- 0.3 | +/- 1.2° |
| C23 | 9.0 mm | 25 | 32 | 2 | 1530 | +/- 0.1 | +/- 0.3 | +/- 1.2° |

Output Shaft Diameter: 8.0 mm

Replacement Couplings: Consult factory for replacement couplings.



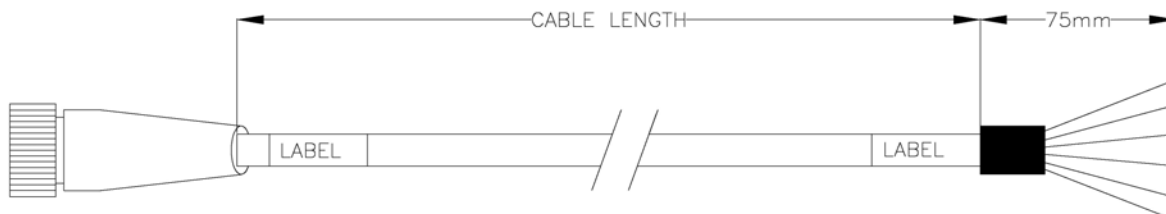
Limit & Home Sensors

| | | | | |
|--------------------------------|--|-------|-------------------------------|-------|
| Switch Type | Proximity | | | |
| Input Power | 5-30VDC, 20mA | | | |
| Output | 100mA (max) | | | |
| Repeatability | +/- 10 microns (unidirectional) | | | |
| Wire Color Code | 3 Wire Sensor | | 4 Wire Sensor | |
| | (+) Supply | Brown | (+) Supply | Brown |
| | Output | Black | (N.O.) Normally Open Output | Black |
| | (-) Supply | Blue | (N.C.) Normally Closed Output | White |
| | | | (-) Supply | Blue |
| LED Color | Yellow | | | |
| Sensor Pack Switch Location | The L11-L14, H11-H14 Limit/Home options are enclosed in a sensor pack that is bolted to the side of the table. These sensors are adjustable along the length of the sensor pack. (Wire terminates in a 5-pin connector; extension cable included) | | | |
| N.O./N.C. Options | Normally Open (N.O.) switches are typically used as home sensors and are typically located between the limit sensors. Normally Closed (N.C.) switches are generally used as defense circuits to prevent damage to components caused by over-travel. | | | |
| Sinking/Sourcing Options | Sinking Switches (a.k.a. NPN): The output lead of this switch provides an electrical path to ground when activated. Sourcing Switches (a.k.a. PNP): The output lead of this switch provides a positive (+) voltage potential relative to ground. Note: refer to the controller's manual for input compatibility. | | | |
| Temperature Range ¹ | +41° F to +158° F | | | |
| Vacuum Rating | 1 x 10 ⁻³ Torr | | | |

1. This range represents the maximum allowable temperature. Catalog specifications are guaranteed only at 20°C.

CAUTION: REVERSING SUPPLY POTENTIAL WILL DESTROY SENSOR
 Brown: +5 to +30VDC Supply
 Blue: Ground Supply
 Black: Signal Output

Sensor Pack Cable Wiring Diagram



| DAEDAL PART NO. | CABLE LENGTH |
|-----------------|--------------|
| 006-1742-01 | 3 METERS |
| 006-1742-02 | 7.5 METERS |

| WIRE COLOR | FUNCTION | PIN # |
|------------------------|-----------------|-------------|
| RED | +5 to +24V DC | A |
| BLUE | LIMIT 1 (LXR -) | B |
| ORANGE | LIMIT 2 (LXR +) | C |
| GREEN | HOME | D |
| BLACK | GROUND | E |
| GREEN w/ YELLOW STRIPE | SHIELD | Shield Case |

NOTE: Limit 2 is the limit switch on the connector end of the sensor pack housing.

Chapter 4 - Base Mounting Procedures

Mounting Surface Requirements

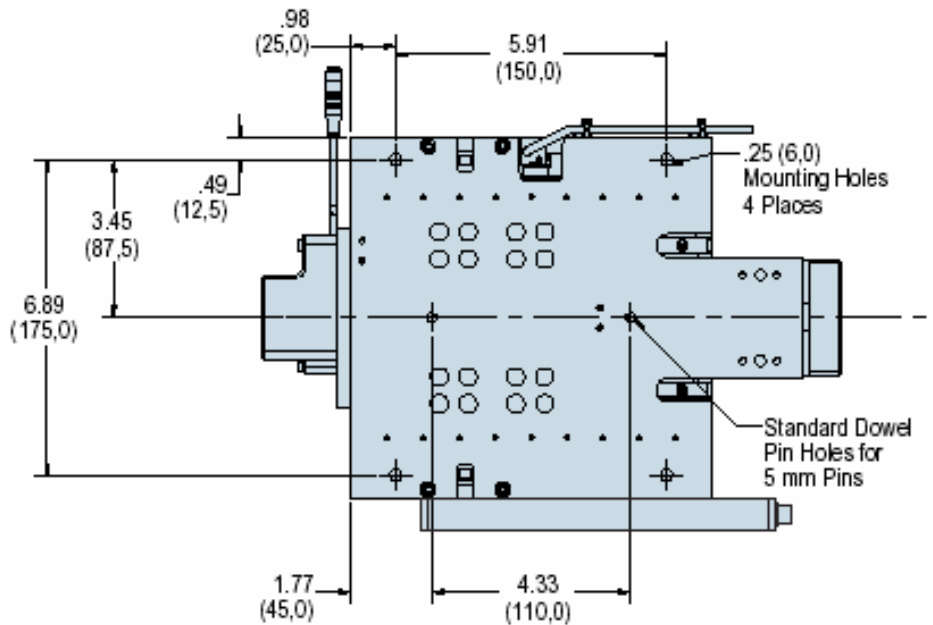
Proper mounting of the ZP200 is essential to optimize product performance. All specifications are based on the following conditions:

- The positioner must be bolted down along its four corners.
- The positioner must be mounted to a flat, stable surface with a flatness error less than or equal to 0.013mm/300mm.
 - Catalog specifications may deviate for positioners mounted to surfaces that do not meet the above conditions.
 - If the surface does not meet these specifications the surface can be shimmed to comply with these requirements.

Base Mounting Methods

Direct Mounting Holes

Bottom View



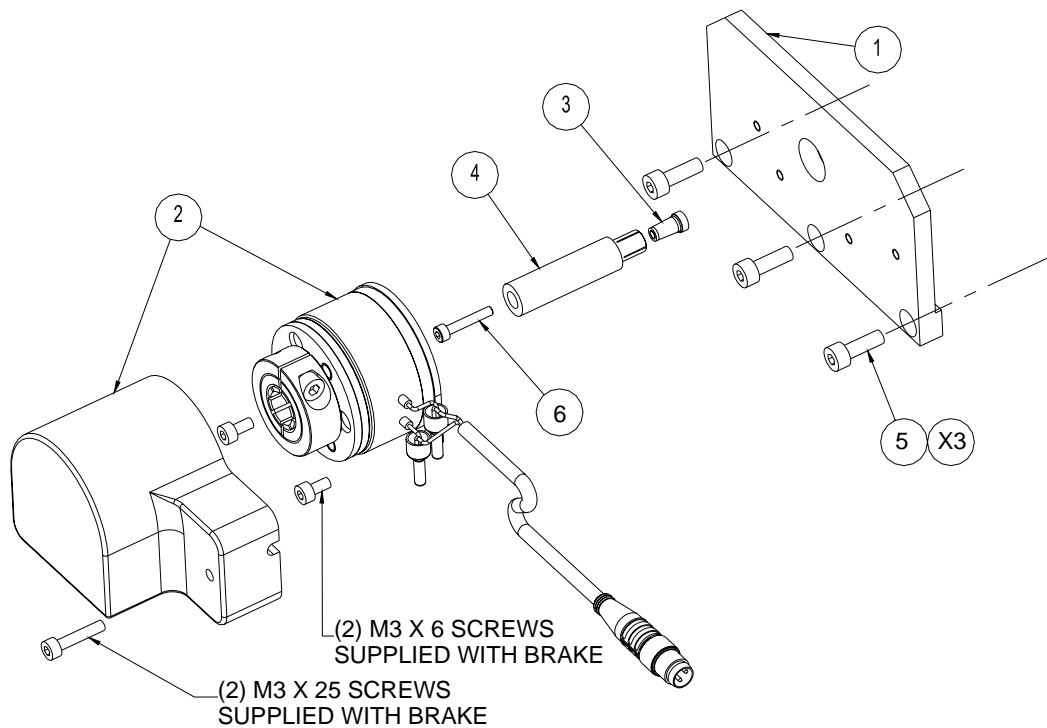
Chapter 5 - Component Mounting Procedures

Center Drive Motor Mounting

Tools Required: Allen Key

- Slip coupling over drive shaft and tighten the screw on the drive shaft side of the coupling. **Note: Do not use Loctite on coupling screws.**
- Slide motor into motor adapter plate and into coupling. Select the appropriate hardware and tighten all bolts.
- Tighten the coupling screw on the motor shaft side. Turn motor by the rear shaft to make sure carriage moves. Then hold carriage and rotate motor again by the rear shaft to make sure coupling won't slip. If the motor does not have a rear shaft be certain that the coupling screws are tight. **Note: Do not use Loctite on coupling screws.**

Rotary Brake Assembly



| | | | |
|---------------|---|---|-------------------------|
| 100-9410-01 | 1 | 1 | Brake Mount |
| 003-3094-01 | 2 | 1 | Brake Kit – Complete |
| 100-2734-01 | 3 | 1 | Shaft Extension |
| 100-8846-01 | 4 | 1 | Mandrel |
| SCH-M004-0010 | 5 | 3 | M4 x 1.25 x 10mm SHCS |
| SCH-M2.5-0030 | 6 | 1 | M2.5 x 1.25 x 30mm SHCS |

Tools Required for Adjustment: Allen Key, Loctite #272, 24V power source Dial indicator

- Clean outside diameter part of the brake mandrel that will slide inside the screw shaft counterbore with Ethyl Alcohol and a clean towel. This counter bore goes inside the idler end of the ball screw. Clean ball screw shaft counter bore using a cotton swab and Ethyl Alcohol.
- Drop the SHCS into the larger diameter end of the mandrel. Apply Loctite #242 to the end of the SHCS threads and start the shaft wedge, tapered end first, onto the SHCS. Apply a light film of Loctite #638 to the shaft wedge and the smaller outside diameter of the brake mandrel.
- Slide the shaft wedge end of the brake mandrel into the ball screw counterbore on the idler end of the ball screw until it stops and the shoulders are touching. Rotate brake mandrel to evenly distribute the Loctite #638. Tighten to 9 in-lbs of torque.
- Verify concentricity. Using a dial indicator, measure the run out (wobble) on the end of the screw shaft by turning the drive screw. Run out should not exceed 0.001 inches.
- Connect the extension cable and energize the brake by connecting the brown wire to the positive (+) and blue wire to the negative (-) on a 24V DC power supply.
- Remove the clutch and clamp from the brake by sliding it off of the magnetic housing. Leaving the brake energized, slide the magnetic housing over the brake mandrel. Mount the magnetic housing to the end block at the idler end, using Loctite #242, schnorr's and hardware provided in the kit.
- Slide the clutch and clamp on to the brake mandrel. Using a feeler gage set the gap at 0.006 inches. Tighten the clamp on the mandrel while pressing against the clutch and feeler gage. Remove feeler gage after the clamp is tightened.
- Manually move the table the entire travel length and check for unusual noises or dragging while energized. If rubbing occurs check mandrel run out. If run out is within tolerance and noise persists then reset the clutch gap.
- Install the brake cover, and tighten without Loctite. Be sure that the wires are snug inside the brake cover, including the strain relief. The yellow cable is to be placed in the wire cavity so that it does not get pinched.

Limit/Home Switch Mounting Procedure

Tools Required For Adjustment: Allen Key

Travel limit sensors signal the motor to stop whenever the table carriage is approaching the end of travel. The home sensor provides a fixed reference point which the carriage can be commanded to return repeatedly.

- The switches can be adjusted by removing the plastic cover on the sensor pack and loosening the switch screws.

NOTE: When adjusting Sensor Pack switches, the screws may be turned a maximum of 1/4 turn. Any further loosening may result in the nut becoming disengaged. If this occurs the sensor pack will need to be disassembled so that the nut can be reattached.

Chapter 6 – Lubrication

Lubrication Procedure

Materials Required: Mobil HP, Isopropyl Alcohol, Clean Cloth, Small Brush

- Lubrication Type:

Use *Mobil HP*. Contact: Mobil Oil Corporation at 800-662-4525 for additional technical information, direct purchase or local distributor information.

- Lubricant Appearance:

Blue and very tacky.

- Maintenance Frequency:

Square rail bearing blocks and ground ballscrew nut packages are lubricated at our facility prior to shipment. For lubrication inspection and supply intervals following shipment, apply grease every 1000 hours of usage. The time period may change depending on frequency of use and environment. Inspect for contamination, chips, etc, and replenish according to inspection results.

- Lubricant Application:

Move the positioner to its highest vertical positioner. Wipe the rails down the entire length with a clean cloth. Apply lubrication on the rails, using a small brush, allowing a film of fresh grease to pass under the wipers and into the recirculating bearings.

Wipe the screw down the entire length with a clean cloth. Apply lubrication on the screw, using a small brush, allowing a film of fresh grease to pass under the wipers and into the recirculating bearings.

Appendix A - Internal Protection

IP Rating

All standard configurations will have an IP00 specification.

****Special care should be taken to avoid all possible pinch points****

Definition

Reference: British standard EN 60529: 1992

This standard describes a system of classifying degrees of protection provided by enclosures of electrical equipment. Standardized test methods and the establishment of a two digit numeric rating verify the extent of protection provided against access to hazardous parts, against ingress of solid foreign objects, and against the ingress of water.

First Number – The first number indicates protection of persons against access to dangerous parts and protection of internal equipment against the ingress of solid foreign objects.

- 1 - Protection against access to hazardous parts with the back of a hand, and protected against solid foreign objects of 50 mm diameter and larger.
- 2 - Protection of fingers against access to dangerous parts, and protection of equipment against solid foreign objects of 12.5 mm diameter and larger.
- 3 - Protection against access to hazardous parts with a tool, and protection against solid foreign objects of 2.5 mm diameter and larger.

Second Number – The second number indicates protection of internal equipment against harmful ingress of water.

- 0 - No special protection provided.

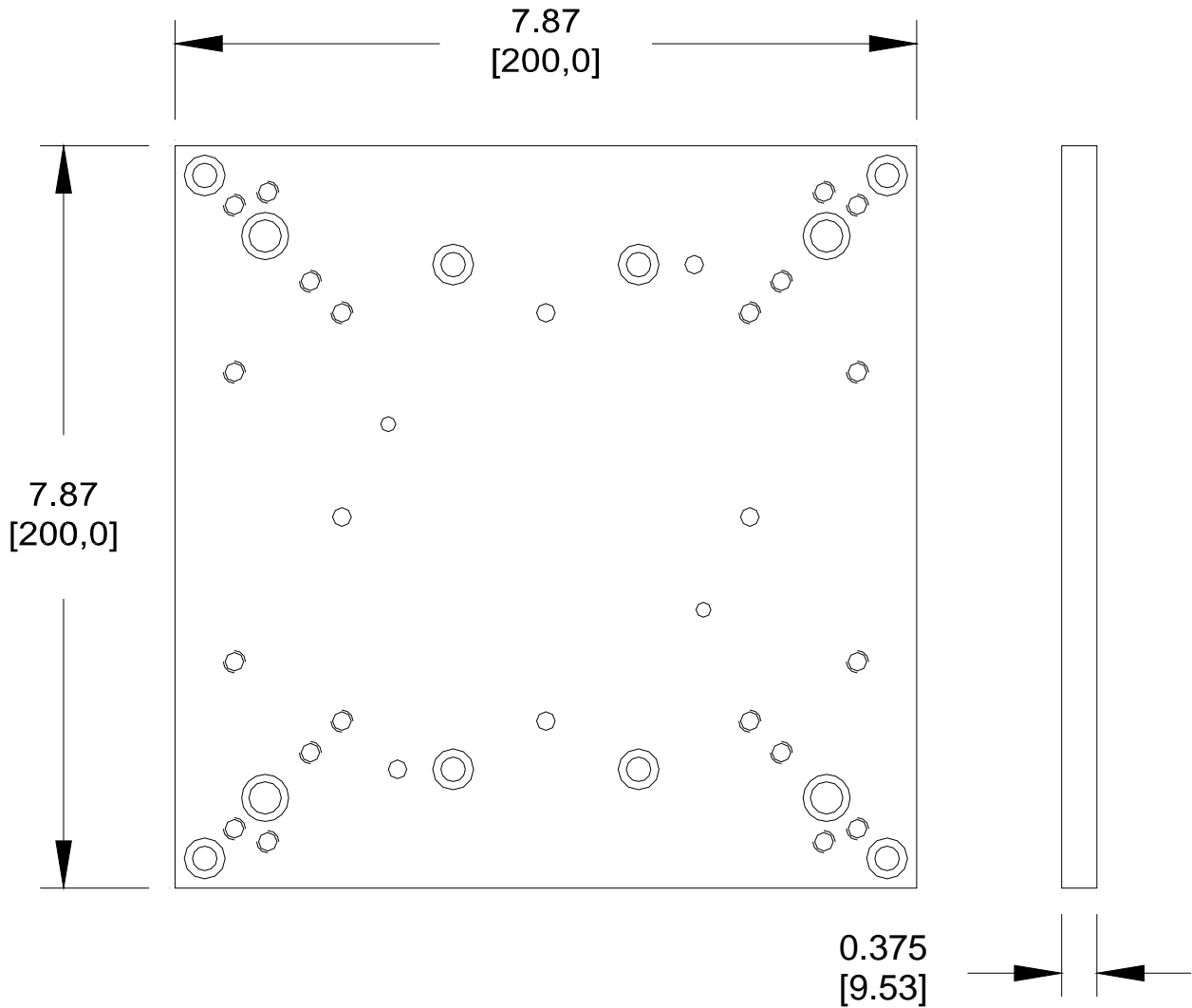
Note: Number Indicators above represent only a partial list of IP Rating specifications.

Warnings (Points of Clarity)

- The specification applies to protection of particles, tools, parts of the body, etc., against access to hazardous parts inside the enclosure. This does not cover external features such as switch pinch points, pinch points caused by the motion of the carriage, or cable carrier assemblies.
- The testing method as specified in the standard uses a solid steel rod of the appropriate diameter at a specified force. The specification does not consider soft or pliable particles. Due to the design of the table and sealing method, a soft particle can compress due to the motion of the table, and reduce its cross-section. This can allow particles to enter the unit.
- In application, shavings or chips commonly created in a machining operation are a greater concern. If any edge or dimension of the “chip” is under the appropriate diameter, it can wedge under and start to lift the seals. This action will allow larger particles to do the same until failure is reached.

Appendix B - Accessories & Spare Parts

Mounting Bracket Dimensions



| | Adapter plate required if the wedge is used as the bottom axis | Adapter plate required if the wedge is used as the top axis |
|------------|--|---|
| 404XR | X | X |
| 404LXR | X | X |
| 406XR | X | X |
| 406LXR | X | X |
| 206 Rotary | X | |