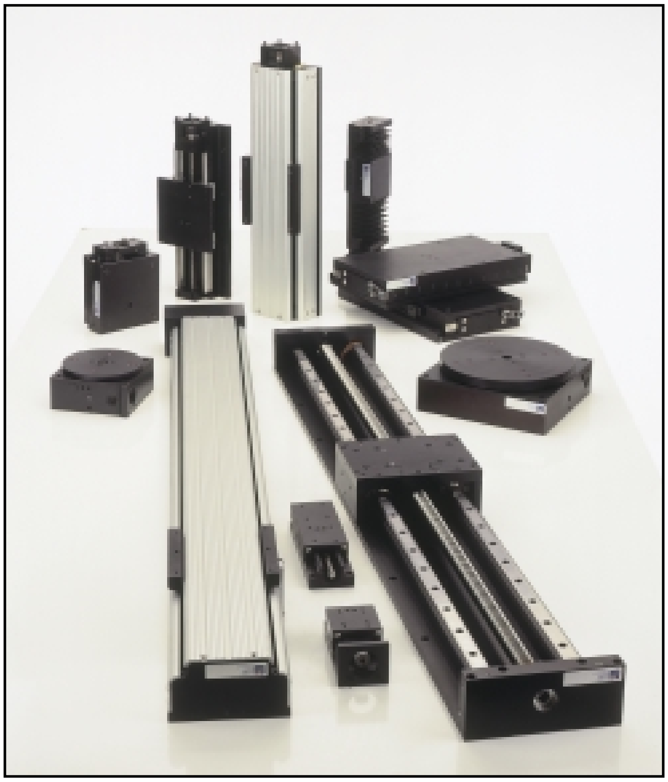
Overview

Do I need a Precision Table?

The first step toward choosing the correct motion system for your application, before considering specific performance parameters or technologies, is to consider which type of motion system might be the best fundamental fit for your application goals.

Electric Cylinders are essentially thrust producing devices that are best suited for applications requiring high axial force with the moment and side loads already properly supported. Screw driven **Rodless Actuators** are also thrust producing devices that are best for axial force applications where the space is limited and a payload must also be supported or carried. As individual components, **Rodless Actuators** are not well suited for moment loading; however, they can be effectively combined into complete **Cartesian Systems** for some multi-axis applications. For higher speed, lower thrust applications, **Rodless Actuators** can be repeatably driven with a timing belt instead of a screw. **Linear Motor Actuators** are ideal for high throughput applications that require repeatability and high system dynamics. **Precision Positioning Tables** are best suited for applications where the accuracy and repeatability requirements are more important than axial thrust of the drive train. **Precision Positioning Tables** can also be used in less precise applications where adequate moment load support is necessary. **Precision Positioning Tables** are ideal building blocks for complete multi-axis positioning systems.



What's New?

- Selection Checklist with Motor Sizing Calculations
- New Application Data Form
- Comprehensive Technology Section (Applications Guide) with Full Performance Verification Section
- Detailed Terminology Section
- Complete Product Specifications with How to Order Examples
- Matched Precision Grade Recirculating Guideway Bearings
- Preloaded Precision Ground Ballscrews — JIS C3 (8 microns per 300mm)
- Lubrication and Life Specifications and Performance Calculations for Drive Screws and Bearings
- Full Coupling Specifications and Performance Calculations
- New Motor and Gearmotor Choices (High Torque Steppers and Ultra Smooth Servos)
- IDeal System — Fully Integrated Positioning Systems with IDC Drives and Controls
- Complete Limit Switch Specifications
- Linear Encoder Application Considerations
- Standard Environmental Preparations for Clean Room and Vacuum Applications
- New Standard Multi-Axis Configurations with How to Order Examples
- Examples of Custom Systems
- Comprehensive Performance Verification and Testing Program (ISO 230-2:1997(E) and ASME B5.54-1992)
- Full Tutorial Explaining Accuracy, Repeatability and Resolution
- Very Low Angular Errors
- Easy-to-Order Basic Stepper and Servo Configurations
- Very Low Friction, Low Torque Designs

Make It An IDeal System
See Intro Pages 6 & 7

Selection

Does this application require a Rotary Precision Table?

Yes

RG Rotary Precision Table
- 6, 8, 10 and 12 inch diameters
- 45:1, 90:1 and 180:1 drive ratios
- Normal loads up to 214 lb. (97 kg)
- Bi-directional Repeatability 40 arc-sec
- Tilt 80 arc-sec (40 arc-sec for Precision option)
- **See page E-50**

No

Does this application require an Open Frame Precision Table?

Yes

HM Open Frame Precision Table
- Typically an X-Y assembly with equal travel lengths
- 6, 8, 12, 18 and 24 inch travel lengths
- 0.2 inch, 10mm and 20mm lead ballscrews
- Normal Loads up to 371 lb. (168 kg)
- Bi-directional Repeatability 9 microns (0.00036 inches)
- Straightness and Flatness 2 microns per 25mm
- **See page E-56**

No

Does this application require a Miniature Precision Table?

Yes

CP3 Miniature Precision Table
- 2.63 inch x 1.75 inch cross section
- 1, 2, 3, 4, 5 and 6 inch travels
- 0.025 inch, 0.1 inch and 0.2 inch leadscrews
- Normal Loads up to 58 lb. (26.3 kg)
- Bi-directional Repeatability 30 microns (0.00120 inches)
- Straightness and Flatness 12 microns per 25mm
- **See page E-62**

No

Which of the following characteristics best describes this application?

Non-recirculating Bearings
- Shorter Travels
- No Heavy Moment Loading
- Cantilevered Top
- Ultra Smooth Motion
- No Heavy Impact Loading
- Acceleration up to 1.0 g

Recirculating Bearings
- Longer Travels
- Moment Loading
- Protective Covers
- Very Smooth Motion
- Impact Loading
- Acceleration up to 2.0 g

Does this application require a small footprint or protective covers?

Yes

PB4 Ultra Precision Table
- 4 inch x 2.5 inch cross section
- 2 and 4 inch travels
- 2.5mm and 0.2 inch lead ballscrews
- Normal Loads up to 79 lb (35.8 kg)
- Bi-directional Repeatability 6 microns (0.00024 inches)
- Straightness and Flatness 2 microns per 25mm
- Protective neoprene bellows covers
- **See page E-68**

No

Does this application require a wider footprint or longer travel?

Yes

CP8 Ultra Precision Table
- 8 inch x 2.5 inch cross section
- 5, 7, 9 and 12 inch travels
- 2.5mm, 0.2 inch and 0.5 inch lead ballscrews
- Normal Loads up to 279 lb. (127 kg)
- Bi-directional Repeatability 6 microns (0.00024 inches)
- Straightness and Flatness 2 microns per 25mm
- **See page E-74**

No

Please refer to the Recirculating Bearing Precision Table Choices

Does this application require normal loading or travel up to the following limits?
(If the answer to these questions is more, please contact IDC to discuss your application.)

97 lb. (44 kg)

RB4A High Precision Table
- 4 inch x 2.5 inch cross section
- 2, 4, 6, 8, 12 and 16 inches
- 2.5mm, 0.2 inch and 0.5 inch lead ballscrews
- Normal Loads up to 97 lb. (44 kg)
- Bi-directional Repeatability 6 microns (0.00024 inches)
- Straightness and Flatness 2 microns per 25mm
- Protective neoprene bellows covers
- **See page E-80**

425 lb. (193 kg)

RB6 and RC6 High Precision Tables
- 6 inch x 3.5 inch cross section
- 6, 12, 18, 24, 30, 36, 42 and 48 inch travels
- 0.2 inch, 10mm and 20mm lead ballscrews
- Normal Loads up to 425 lb. (193 kg)
- Bi-directional Repeatability 6 microns (0.00024 inches)
- Straightness and Flatness 2 microns per 25mm

Which covers are needed?

Protective Bellows

RB6 High Precision Table
- **See page E-86**

Aluminum Plate

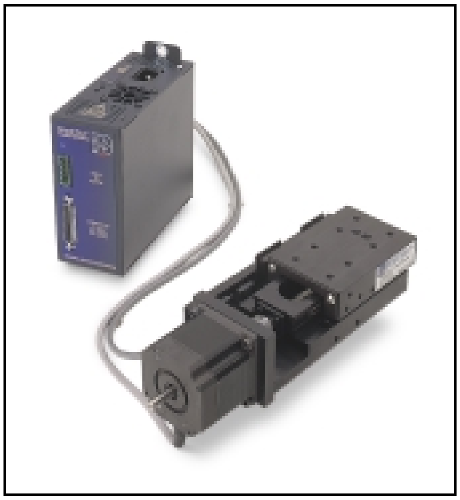
RC6 High Precision Table
- **See page E-92**

1250 lb. (567 kg)

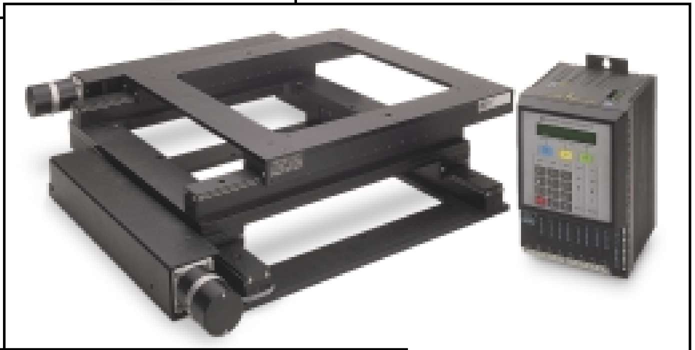
RB8 High Precision Table
- 8 inch x 3.5 inch cross section
- 6, 12, 18, 24, 30, 36, 42, 48, 54 and 60 inch travels
- 0.2 inch, 10mm and 1.0 inch lead ballscrews
- Normal Loads up to 1250 lb. (567 kg)
- Bi-directional Repeatability 6 microns (0.00024 inches)
- Straightness and Flatness 2 microns per 25mm
- Protective neoprene bellows covers
- **See page E-98**

Overview

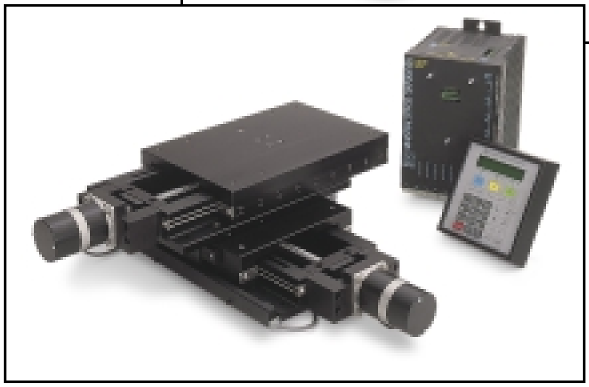
RG Rotary Precision Table



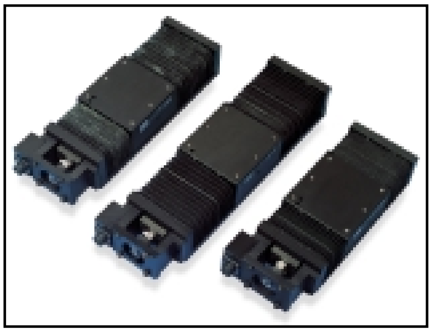
CP3 Miniature Precision Table



HM Open Frame Precision Table



CP8 Ultra Precision Table



PB4 Ultra Precision Table

Models	**RG**	**HM**	**CP3**	**PB4**	**CP8**
Type	Rotary Axis	Linear Axis	Linear Axis	Linear Axis	Linear Axis
Series	Precision	Precision	Precision	Ultra Precision	Ultra Precision
Travel or Diameter (in.)	6, 8, 10, 12	6, 8, 12, 18, 24	1, 2, 3, 4, 5, 6	2, 4	5, 7, 9, 12
Normal Load (lb.)	214	up to 371	up to 58	up to 79	up to 279
Height (in.)	varies with diameter	3.0	1.75	2.5	2.5
Width (in.)	varies with diameter	varies with travel	2.63	4.0	8.0
Drive Screw	Worm Gear	Ballscrew	Leadscrew	Ballscrew	Ballscrew
Lead or Ratio	45:1, 90:1, 180:1	0.2 in., 10mm, 20mm	0.025 in., 0.1 in., 0.2 in.	2.5mm, 0.2 in.	2.5mm, 0.2 in., 0.5 in.
Bearing Style	Rotary Recirculating	Non-recirculating	Non-recirculating	Non-recirculating	Non-recirculating
Bearing Type	2 Row Angular Contact	Ball Bearing	Cross Roller	Cross Roller	Cross Roller
Bi-directional Repeatability	40 arc-sec	9 microns	30 microns	6 microns	6 microns
Straightness & Flatness	80 arc-sec*	2 microns per 25mm	12 microns per 25mm	2 microns per 25mm	2 microns per 25mm
(Precision Option)	40 arc-sec*	N/A	N/A	1 micron per 25mm	1 micron per 25mm
Covers	N/A	N/A	N/A	Neoprene Bellows	N/A
Motor Type	Stepper or Servo	Stepper or Servo	Stepper or Servo	Stepper or Servo	Stepper or Servo
NEMA Motor Size	23	23	17 or 23	23	23
Encoder Resolution (um)	N/A	1, 2	1, 2	1, 2	1, 2
Page	E-50	E-56	E-62	E-68	E-74

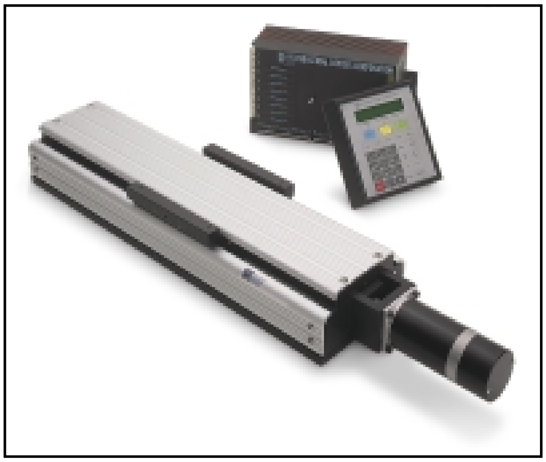
* Tilt is measured instead of Straightness and Flatness for RG Rotary Precision Tables

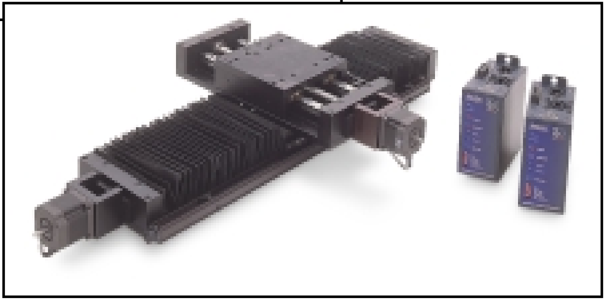
Overview

RB4A High Precision Table

RB8 High
Precision Table

RC6 High Precision Table





RB6 High Precision Table

Models	**RB4A**	**RB6**	**RC6**	**RB8**
Type	Linear Axis	Linear Axis	Linear Axis	Linear Axis
Series	High Precision	High Precision	High Precision	High Precision
Travel or Diameter (in.)	2, 4, 6, 8, 12, 16	6, 12, 18, 24, 30, 36, 42, 48	6, 12, 18, 24, 30, 36, 42, 48	6, 12, 18, 24, 30, 36, 42, 48, 54, 60
Normal Load (lb.)	97	425	425	1250
Height (in.)	2.5	3.5	3.5	3.5
Width (in.)	4.0	6.0	6.0	8.0
Drive Screw	Ballscrew	Ballscrew	Ballscrew	Ballscrew
Lead or Ratio	2.5mm, 0.2 in., 0.5 in.	0.2 in., 10mm, 20mm	0.2 in., 10mm, 20mm	0.2 in., 10mm, 1.0 in.
Bearing Style	Recirculating	Recirculating	Recirculating	Recirculating
Bearing Type	Linear Guideway	Linear Guideway	Linear Guideway	Linear Guideway
Bi-directional Repeatability	6 microns	6 microns	6 microns	6 microns
Straightness & Flatness (Precision Option)	2 microns per 25mm 1 micron per 25mm	2 microns per 25mm 1 micron per 25mm	2 microns per 25mm 1 micron per 25mm	2 microns per 25mm 1 micron per 25mm
Covers	Neoprene Bellows	Neoprene Bellows	Aluminum Plate	Neoprene Bellows
Motor Type	Stepper or Servo	Stepper or Servo	Stepper or Servo	Stepper or Servo
NEMA Motor Size	23	23 or 34	23 or 34	34
Encoder Resolution (um)	1, 2	1, 2	1, 2	1, 2
Page	E-80	E-86	E-92	E-98

Precision Tables Selection Checklist

The following steps describe the process of selecting a Precision Positioning Table to match your application requirements.

☐ 1) Simple Applications with Standard IDC Products (Simple Checklist)

For relatively simple single axis, X-Y, or X-Y-Theta applications that can be solved with Standard IDC Precision Tables, please refer to the General Selection Guidelines (E-3). For custom systems, please proceed to Step 2. Please remember to add up the Weights and Error Bands of each Precision Table for Multi-Axis Configurations. Please refer to the Technology section and the individual product sections for further details. Completing the Product Selection Worksheet (E-11 to E-14) is also strongly recommended.

☐ A) If you are able to decisively select standard IDC Precision Tables based on the selection flow chart, then proceed to the *How to Order* pages for each chosen Precision Table. Otherwise, proceed to step 2.

☐ B) Each *How to Order Section* has a Basic Stepper and a Basic Servo Configuration. These Basic Configurations provide a Precision Table solution that has been optimized for the majority of applications. Choosing a Basic Configuration also provides the best deliveries and pricing. Standard catalog options (Drive Screws, Couplings, Motors, Limit Switches, Encoders and Covers) can typically be substituted within the Basic Configuration with minimal impact on delivery. Pricing will vary according to the components chosen. Please refer to the *How to Order* section or contact IDC for further details.

☐ C) Each *How to Order* section also has information on how to add several standard Precision Table options. Please refer to the *How to Order* section and order appropriately. Please note that certain Environmental Preparations, such as Vacuum Preparation, may require additional lead-time.

- Standard IDC Drive and Control Integration (IDeal System).
- Standard Multi-Axis Configurations.
- Standard Clean Room and Vacuum Environmental Preparations.
- Standard Performance Verification Tests.

Please refer to the Technology section or contact IDC for further details.

Please contact IDC to review your choices if you are unsure in any way.

☐ 2) Complete the Product Selection Worksheet (Full Checklist) — Loading Considerations

Specifying a Precision Positioning System starts by evaluating the forces and moments that act on each axis. It is important to remember that 5 out of the 6 degrees of freedom for each axis will be static (not moving). The direction of travel is the dynamic (moving) degree of freedom. For Multi-Axis systems, please remember to include the static (weights and cantilevered loads), dynamic (forces and moments generated by system motion) and transient (externally applied) forces and moments generated by the other axes and machine operations. Please note that Multi-Axis systems require a detailed drawing to properly evaluate the loading conditions.

The calculations that follow are straightforward Newtonian Physics. Please refer to page E-10 and IDC's Engineering section for further details on how to perform these calculations. Certain bearing designs, such as recirculating bearings, are better suited for handling moment or impact loads. Please refer to the Structure and Bearings Section for further details. It is important to note that any structure will deflect when subjected to a force or moment. Ultimately, the amount of deflection that is acceptable must be determined based on the application requirements. Complete stiffness and compliance data is provided in each individual product section.

☐ A) Evaluate the forces (normal, side and axial) that act on each individual axis. Include static forces, dynamic forces, frictional forces and transient forces. Assume a coefficient of friction of 0.01 for initial friction calculations.

☐ B) Evaluate the moments (roll, pitch and yaw) that act on each individual axis. Include static moments, dynamic moments and transient moments. Applications with significant moment loading requirements typically utilize Precision Tables with recirculating bearings.

☐ C) If your application requires impact or moment loading, recirculating bearings will be necessary.

☐ D) Evaluate the type of application (linear, rotary, open frame or miniature), the travel (or diameter for rotary applications), and the loading requirements, and consult the General Selection Guidelines (E-3). A specific Precision Table (or at least a range of Precision Tables) should be fairly obvious. If this is not the case, please complete as much of the Product Selection Worksheet as possible, and fax it and the supporting documentation to IDC. Please remember that IDC defines travel as the distance between the end of travel limit switches.

☐ E) Compare the coefficient of friction of the selected Precision Table against the initial calculation assumptions. Recalculate if necessary.

☐ F) To further determine the initial suitability, consult the individual product section of a selected Precision Table. Review the compliance and stiffness data to determine if the specific Precision Table is still appropriate based on predicted deflection.

☐ G) Review the bearing life calculations to determine if the specific Precision Table is still appropriate based on product life cycle considerations.

☐ H) If this analysis does not provide a conclusive result, please complete as much of the Product Selection Worksheet as possible, and fax it and the supporting documentation to IDC.

☐ **3) Complete the Product Selection Worksheet (Full Checklist) — Dynamic Considerations**

In reality, the dynamic considerations are also considered during the loading analysis. For example, the axial load of a Linear Precision Table is affected by the acceleration ($F = ma$). To determine the velocity and acceleration based on the distance to move and time to move please refer to IDC's Engineering section.

☐ A) Calculate the required velocity and acceleration. Based on the velocity requirements, a specific drive screw should be obvious. Please consult the Drive Screw section for further details. Compare the calculated velocity and acceleration to the limits for your chosen Precision Table. If these values exceed the Precision Table limits, consider using a different Drive Screw, a different Precision Table or altering your move profile. If this is not possible, please consult IDC to discuss your application requirements.

☐ B) After selecting a specific drive screw, review the drive screw life calculations to determine if the specific Precision Table is still appropriate based on product life cycle considerations.

☐ C) For rotary and leadscrew driven applications, calculate the Duty Cycle. Please refer to IDC's Engineering section for details on how to calculate Duty Cycle. If the Duty Cycle exceeds the limits for your chosen Precision Table, consider using a ballscrew (for linear axes) or contact IDC to discuss your application requirements.

☐ D) Steppers are typically well suited for lower speed, higher torque applications without feedback. In contrast, Servos typically have a much flatter speed torque curve and rotary encoder feedback. Each IDC Precision Table has a Basic Stepper and Basic Servo Configuration. These Basic Configurations provide a Precision Table solution that has been optimized for the majority of applications. To verify that the motor for each axis is appropriate, it is necessary to perform the motor sizing calculations (E-10), and verify resolution requirements. Each Precision Table provides the necessary efficiency and inertia data for each drive screw and travel choice. Complete motor sizing calculation information is available in IDC's Engineering section. Please refer to the Motor section for further details on the consequences involved with different motor and gearmotor choices. If the Basic Configuration Motor does not have sufficient torque, considering using a different IDC motor from the *How to Order* page. Please remember not to exceed the maximum input torque limits for your chosen Precision Table. Please contact IDC if you are having motor sizing difficulties, or if you want to use a non-IDC motor. See step 6.

☐ E) After selecting a motor, it is necessary to select the correct coupling. Typically, Servos use Bellows couplings and Steppers use Oldham couplings. Selecting a coupling that has poor torsional stiffness could cause positioning and resonance problems. Please refer to the Coupling section for further details on coupling selection.

Precision Tables Selection Checklist

☐ F) Determining the minimum incremental movement that is possible for a Positioning System can be somewhat complicated. Typically, System Resolution can be increased by using high torque, high resolution motors with low inertia, using rigid mechanical components (couplings, drive screws, etc.), minimizing system friction, and minimizing load inertia. Because System Resolution is significantly dependent on load inertia, it must be simulated and verified for a given payload and orientation. Please refer to the Performance Verification section for further details.

☐ G) If this analysis does not provide a conclusive result, please complete as much of the Product Selection Worksheet as possible, and fax it and the supporting documentation to IDC.

☐ 4) Complete the Product Selection Worksheet (Full Checklist) — Movement Considerations

Ultimately, the major reason for selecting a Precision Table, instead of an actuator, is the quality of movement that can be achieved. It is first necessary to evaluate the movement requirements of your application. For a better understanding of these concepts and terminology, please refer to the Performance Verification and Terminology sections.

☐ A) Determine the type of movement (unidirectional or bi-directional) and the accuracy and repeatability requirements.

☐ B) Compare these requirements to limitations of your selected Precision Table. If your requirements are less stringent than the Precision Table limits, then an encoder is not necessary. Encoders can be used to improve the on-axis positioning results, but they also have significant limitations. Specifically, they are blind to off-axis errors. It is also important to note that having a 1 micron encoder does not guarantee that a Positioning System will be able to make 1 micron incremental movements. Please refer to the Encoder and Performance Verification sections for further details to determine if an encoder is necessary.

☐ C) For contouring applications, please refer to the maximum thrust load values for each specific ballscrew. Contouring applications, specifically circular interpolation applications, may have additional backlash deviations if these thrust load limits are exceeded. It is also necessary to consider encoder limitations in contouring applications. Please refer to the Encoder and Performance Verification sections for further details.

☐ D) It is also necessary to evaluate the off-axis errors to determine if their deviations are acceptable, especially scanning applications. This should have already been considered for heavy load applications in step 2. For lighter load applications where the inherent off-axis errors of the Precision Table dominate, compare the Precision Table limits to your application requirements. For applications that require lower off-axis errors, most Precision Tables offer a Precision Assembly option. Please refer to the individual product sections and the Performance Verification section for further details.

☐ E) Certain high performance applications that utilize error compensation require Performance Verification Testing. Other customers require this type of quality assurance as part of their overall quality certification program. Please refer to the Performance Verification section for more information on standard IDC testing programs to learn how to maximize the performance of your system.

☐ F) If this analysis does not provide a conclusive result, please complete as much of the Product Selection Workshet as possible, and fax it and the supporting documentation to IDC.

☐ 5) Complete the Product Selection Worksheet (Full Checklist) — Environmental Considerations

In reality, environmental considerations are also considered during the initial evaluation of the Positioning System. Certain geometric and physical limitations are obvious from the start and directly influence the initial selection. All standard Multi-Axis configurations are detailed in the *How to Order* section of each individual product section. Please refer to the Multi-Axis section for further details and options. The remaining discussion is concerned with Environmental considerations.

☐ A) Protective covers are part of the Basic Configuration for every Precision Table that can accommodate them. Covers should also be omitted for vacuum applications or especially clean environments. Please contact IDC if special environmental protection is required.

☐ B) IDC provides standard preparations for clean room and vacuum environments. Special environmental conditions can also be accommodated. Please refer to the Environmental section and the individual product sections for further details. Please contact IDC if your application has requirements that exceed the catalog specifications.

☐ C) Please provide a detailed drawing showing the physical layout of your application. IDC Precision Tables have standard orthogonality tolerances. Please include any special requirements if they exceed standard specifications.

☐ D) If this analysis does not provide a conclusive result, please complete as much of the Product Selection Workshet as possible, and fax it and the supporting documentation to IDC.

☐ **6) Complete the Product Selection Worksheet (Full Checklist) — Control Considerations**

Although certain control considerations have already been evaluated (motors, encoders, etc.), others have not. IDC drives and controls can be integrated into your Positioning System as part of an IDeal System solution.

☐ A) If IDC drives and controls will be used, remember to choose the IDeal System option to have the drives and controls integrated into your positioning system. Please refer to the IDeal System section for further details.

☐ B) Limit switches are included in the Basic Configuration for each Precision Table. They may be eliminated, or special limit switches may be required. Please refer to the Limit Switch section for further details. Please contact IDC if non-standard limit switches are required.

☐ C) Please provide any relevant information regarding any non-IDC drives or controls that are required by your application.

☐ D) Please provide complete motor information and a dimensional drawing for all non-IDC motors.

☐ E) If this analysis does not provide a conclusive result, please complete as much of the Product Selection Worksheet as possible, and fax it and the supporting documentation to IDC.

☐ **7) Complete the Product Selection Worksheet (Full Checklist) — Special Considerations**

At this point, a standard IDC solution has been chosen and confirmed or the requirements for a custom system have been specified. Please refer to the *How to Order* sections to verify that your Positioning System has been ordered correctly. If a custom system is required, please record any special system requirements (e.g. special cable lengths, custom limit switch position, etc.) in this space on the Product Selection Worksheet.

☐ **8) Fax the Product Selection Worksheet (Full Checklist) and the Supporting Documentation to IDC.**

IDC will review the information that has been sent. Standard product selections will be verified and quoted based on the information that has been provided. Custom system requests will be evaluated and quoted based on the information that has been provided. You will be contacted if additional information is required. A local IDC distributor can also be sent to your facility to directly evaluate your application requirements.

Quick Calculation Reference

Basics

Force = mass x acceleration

Torque = force x distance

For Linear Axes

Sum of Moments = 0

Sum of Forces = 0, except direction of travel F = m x a (mass times acceleration)

For Rotary Axes

Sum of Forces = 0

Sum of Moments = 0, except axis of rotation $T = J \times \alpha$ (rotary inertia times angular acceleration)

Typical Analysis

($\theta = 0$ degrees – horizontal)

($\theta = 90$ degrees – vertical)

(g = acceleration of gravity)

(m = mass)

Normal Force = $m \times g \times \cos\theta$

(μ = coefficient of friction)

Axial Force = $(m \times g \times \sin\theta) + (\mu \times m \times g \times \cos\theta) + (m \times a)$ + externally applied force

Stiffness

Stiffness = force/deflection = K

Compliance = deflection/moment

Linear Deflection = force/stiffness

Angular Deflection = compliance x moment

$1/K\text{ (total)} = (1/K_1) + (1/K_2) + (1/K_3) + (1/K_4) + \ldots$

Move Profile

V = 1.5 x (D/T) – trapezoidal move profile only

$A = 4.5 \times (D/T^2)$ – trapezoidal move profile only

(D = distance, T = Time)

Duty Cycle

Duty Cycle = move time/total time

Typical Motor Sizing Calculations for Linear Axes

Rotary to Linear Motion Conversion

Torque(1) = (Force x lead) / (2 x π x efficiency)

(Force = total axial force)

ω (angular velocity) = V (velocity)/L (lead)

α (angular acceleration) = a (linear acceleration)/L (lead)

Constant Speed For Motor Sizing

Torque(2) = (torque(1) + running torque (due to inherent friction)) / (gear reduction ratio)*

*(if there is no gear reduction, the ratio = 1)

Acceleration For Motor Sizing

J = rotary inertia

Torque(3) = Torque(2) + J(total) x α

J(total) = J(gear reduction) + [J(precision table)/(gear reduction ratio)^2]

J(precision table) = J(coupling) + J(drive screw) + (m(moving) x (lead/2 x π)^2)

m(moving) = total moving mass including carriage

$\alpha < \alpha$ (max) of the motor

RMS Torque

$T(rms) = \sqrt{T(a)^2 \times t(a) + T(b)^2 \times t(b) \times T(c)^2 \times t(c)} \;/\; (t(a) + t(b) + t(c))$

T = torque

t = time

Typical Safety Margins For Motor Sizing

Servo 20%

Stepper 50%

Inertia Ratio for Motor Sizing

(Load Inertia / Motor Inertia) < 5 (ideally)

Please refer to the Engineering Section for further details.

Product Selection Worksheet

For application assistance, please contact IDC by phone, fax or e-mail.

Prepared By

Name ______________________________

Company ______________________________

Phone ______________________________

Fax ______________________________

Email ______________________________

Address ______________________________

____

____

Prepared For

Name ______________________________

Company ______________________________

Phone ______________________________

Fax ______________________________

Email ______________________________

Address ______________________________

____

____

Customer's primary business ______________________________

____

Please describe your application ______________________________

____

____

Current IDC user? Yes ☐ No ☐

Which products do you use? ______________________________

If not a current IDC customer, which precision positioning products do you currently use? (Company & Model) ____

____

How did you hear about IDC? ______________________________

Do you want a local IDC distributor to contact you? Yes ☐ No ☐

Project Time Frame and Requirements

Quote needed by ______________________________

Prototype needed by ______________________________

First production needed by ______________________________

Full production needed by ______________________________

Budget ______________________________ per system

How many? ______________________________

How many? ______________________________ per month

How many? ______________________________ per month

Please include drawings, comments or additional information on separate pages.

Product Selection Worksheet

Loading Considerations — Externally Applied

(please include units in your answer)	**Axis 1**	**Axis 2**	**Axis 3**	**Axis 4**
Linear or Rotary				
Travel or Diameter				
Orientation (horizontal or vertical)				
Payload (weight)				
Static Normal Load				
Dynamic Normal Load				
Transient Normal Load				
Static Side Load				
Dynamic Side Load				
Transient Side Load				
Static Axial Load				
Dynamic Axial Load (thrust)				
Transient Axial Load				
Static Roll Moment				
Dynamic Roll Moment				
Transient Roll Moment				
Static Pitch Moment				
Dynamic Pitch Moment				
Transient Pitch Moment				
Static Yaw Moment				
Dynamic Yaw Moment				
Transient Yaw Moment				
Impact or Vibration Load				
Center of Gravity (load orientation)				

Please provide a drawing detailing the loading requirements of your application.
Please use negative numbers to indicate inverted loads.
Please refer to the Product Selection Checklist and the Engineering Section for loading calculation examples.

Product Selection Worksheet

Dynamic Considerations

(please include units in your answer)	**Axis 1**	**Axis 2**	**Axis 3**	**Axis 4**
Type of Motion (point to point, contouring, etc.)				
Distance to Move				
Time to Move				
Dwell Time				
Duty Cycle				
Move Profile (trapezoidal, triangular, S-curve)				
Velocity				
Acceleration				
Settling				
System Resolution (minimum incremental motion)				
Required Life (cycles, distance, etc.)				
Velocity Ripple				

Please provide a drawing detailing the move profile, acceleration, top speed, settling time, etc.

Movement Considerations

(please include units in your answer)	**Axis 1**	**Axis 2**	**Axis 3**	**Axis 4**
Unidirectional or Bi-directional				
Repeatability				
Accuracy				
Contouring Accuracy				
Maximum Roll Error (tilt error for rotary axes)				
Maximum Pitch Error (eccentricity for rotary axes)				
Maximum Yaw Error (runout for rotary axes)				
Straightness (microns per 25mm)				
Flatness (microns per 25mm)				
Performance Verification (type of testing required)				

Please refer to the Performance Verification section for further details.

Product Selection Worksheet

Environmental Considerations

(please include units in your answer)	**Axis 1**	**Axis 2**	**Axis 3**	**Axis 4**
Type of System (X, X-Y, X-Y-Z, X-Y Theta, H Gantry)				
Geometric Limitations (height, width, length, open frame)				
Temperature Range				
Clean Room Class				
Vacuum Pressure				
Other Environmental (mists, particulates, corrosives, etc.)				
Covers (bellows, plate, etc.)				
Orthogonality				

Please provide a drawing detailing the physical requirements of your application.
Please refer to the Multi-Axis and Environmental sections for further details.

Control Considerations

(please include units in your answer)	**Axis 1**	**Axis 2**	**Axis 3**	**Axis 4**
Motor Type (stepper, servo, etc.)				
Motor Size and Model (NEMA 23, metric, etc.)				
Amplifier Required				
Control Type and Model (motion controller, PLC, CNC, etc.)				
Encoders Required (rotary, linear, interferometer, etc.)				
Encoder Resolution				
Limit Switch Type (Hall Effect, optical, etc.)				
Limit Switch Configuration (end of travel plus home, etc.)				

Please provide detailed information and dimensional drawings if non-IDC motors are required.
Please refer to the Technology section for further details.

Special Considerations

(please include units in your answer)	**Axis 1**	**Axis 2**	**Axis 3**	**Axis 4**

Please contact IDC for application assistance.

Technology

Structure and Bearings

Structure

The standard structural material for IDC's Precision Positioning Tables is black anodized aluminum alloy (6061 and cast tool plate). All critical surfaces are precision ground to minimize angular error tolerances (roll, pitch and yaw). Aluminum is relatively stiff, light weight, corrosion resistant, and easy to machine. Aluminum can also be nickel plated for clean room and vacuum applications. Please refer to the Environmental Section for further details.

Other materials, such as stainless steel, may be necessary for applications that require a stiffer or more corrosion resistant structure. Please contact IDC if your application has requirements that exceed the capabilities of Aluminum.

Mounting

All mounting holes, except on the CP3, have steel locking threaded Helicoil inserts to prevent mounting screws from becoming loose.

CP3, RB4A and PB4	10-32 UNC-2B
RG, HM, CP8, RB6, RC6 and RB8	1/4-20 UNC-2B

Please refer to the individual product sections for further information regarding mounting helicoil locations.

Bearing Basics

Simply stated, the role of the structure and bearings is to support the load that is being positioned while minimizing angular errors (those inherent to the Positioning Tables as well as those caused by deflection from loading) and the coefficient of friction. Each individual Precision Table product section provides relevant data regarding the coefficient of friction, inherent angular errors, straightness and flatness, loading limits and compliances. A lower angular error, Precision Assembly Option is also available for certain Precision Tables. Please refer to the Performance Verification Section and the individual product sections for further details.

Applications Information

A low coefficient of friction is desirable for several reasons. The main reason is system resolution. Lower coefficients of friction allow smaller incremental movements. Another benefit of low system friction is decreased wear.

Every motion system has inherent angular errors (deviations from zero in roll, pitch and yaw). These can be minimized by grinding structural surfaces and utilizing high precision bearings. All IDC Recirculating Bearing Precision Tables use precision grade linear guideways (cumulative running parallelism of 15 microns per 2 meters). All IDC Precision Tables, except the CP3 and HM have a special High Precision Assembly Option to specifically minimize angular errors and improve straightness and flatness. Please refer to the individual product sections for further information.

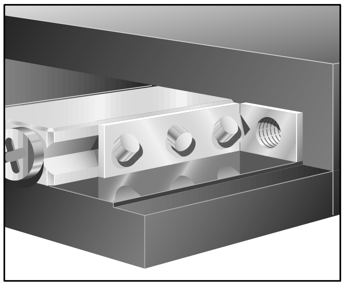
Loading Limits — A Closer Look

Before beginning this discussion a few points must be clarified. First, any motion system, when subjected to a load, will deflect. Second, as described in the previous paragraph, every motion system has some inherent angular error. Third, when comparing Positioning Table specifications, it is important to differentiate between bearing specifications and positioning table specifications.

Bearings are typically rated for two different load capacities. The Static Capacity of a bearing is typically defined as the amount of load the bearing can sustain before permanently deforming the bearing way by 0.0001 times the diameter of the contact element. Because the steel bearing elements are approximately 3 times stiffer than the aluminum structure, it would be irresponsible to encourage loading up to this limit by publishing this value. The second bearing rating is the Dynamic Capacity, which is typically defined as the load under which 90% of the contact elements in the bearing will retain geometric integrity after traveling a fixed distance (typically 50km). It is very important to note that the dynamic capacity is used for estimating bearing life only. Because the steel bearings are approximately 3 times stiffer than the aluminum structure, the entire Positioning Table would deflect tremendously if loaded to the full Dynamic Capacity of the bearings. Therefore, IDC has set loading limits based on typically acceptable deflections (typically a multiple of the inherent deviations). Ultimately, it is the user's decision how much deflection is acceptable. Please refer to the compliance data in the product sections.

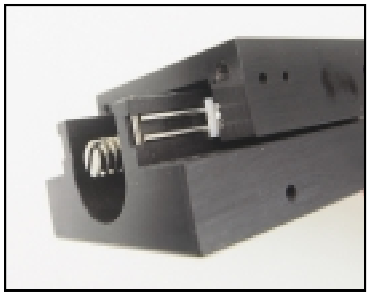
Non-recirculating Linear Bearings

Non-recirculating bearings are typically used in short travel, light load applications. The main advantages of the non-recirculating design are smooth motion with low angular errors and no wiper stiction. For example the PB4 and CP8 Precision Tables have the lowest angular errors of any standard positioning table. Also, the HM Open Frame Positioning Table is ideal for back lighting applications that require smooth motion. Non-recirculating bearings can also be relatively inexpensive. For example, the miniature CP3 employs non-recirculating cross roller bearings.



Cross Roller Bearings

Non-recirculating bearings also have some application limitations. Because they are point contact bearings, non-recirculating bearings are not well suited for applications with impact or high moment loads. Also, the Positioning Table top will extend beyond the base of the table at the ends of travel. Therefore, sufficient space must be allocated for the top's extension at the end of travel.



Non-recirculating bearings in a CP3

Another consequence of having a cantilevered top is environmental protection. It is not possible to attach bellows or way covers to the HM, CP3 or CP8. Only the PB4 can be protected with neoprene coated polyurethane bellows covers. Finally, non-recirculating bearings are not well suited for high acceleration or vertical applications due to retainer creep considerations. Only the miniature CP3 precision table is routinely used in vertical applications. IDC's manufacturing technology minimizes the retainer creep associated with typical designs.

Bearing Choices

HM	Non-recirculating Ball Rod Bearing
CP3, PB4 and CP8	Non-recirculating Cross Roller Bearing

Lubrication and Life

Non-recirculating bearings, when used in standard environments, should be lubricated at least every 1-2 million inches of travel (25km-50km) with a light machine oil. Other lubricants are necessary in non-standard environments. For more information on lubrication, please visit IDC's web site to download the Precision Table's manual and CAD files.

The bearing life is typically shorter than the ballscrew life for a Precision Positioning Table because the load carried by the bearings typically exceeds the thrust load, provided that neither the bearings nor the ballscrew becomes contaminated. To theoretically estimate the life of the bearings, it is necessary to know the peak load applied to the bearings and the Dynamic Load Capacity of the bearings (provided for each positioning table in the individual product sections). Please note that these calculations provide the B10 life for the contact elements (the life at which 90% of all contact elements maintain geometric integrity).

Ball Rod Bearings

Please note that non-recirculating cross roller bearing life (CP3, PB4 and CP8) is governed by a 10/3 exponent due to the increased surface contact. In contrast, non-recirculating ball rod bearing life (HM for example) follows a 3rd power relation.

Example: CP8 — 9" travel

Dynamic Capacity = 246 kg
Supported Load (max.) = 30.8 kg
Life (km) =

$$\left(\frac{\text{Dynamic Capacity}}{\text{Supported Load}}\right)^{10/3} \text{ x } 50 = \left(\frac{246}{30.8}\right)^{10/3} \text{ x } 50 = 50923 \text{ km}$$

Example: HM — 12" travel

Dynamic Capacity = 323 kg
Supported Load (max.) = 56.2 kg
Life (km) =

$$\left(\frac{\text{Dynamic Capacity}}{\text{Supported Load}}\right)^{3} \text{ x } 50 = \left(\frac{323}{56.2}\right)^{3} \text{ x } 50 = 9492 \text{ km}$$

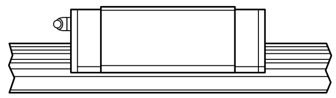
Note: 25 km equals approximately 1 million inches.

Rotary Table Bearings

The RG Rotary Table Bearings are 2 row angular contact ball bearings (Dynamic Capacity = 194 kg). Bearing life estimation uses the same formula used for the HM non-recirculating bearings (3rd power relation), except that the results are expressed in millions of revolutions.

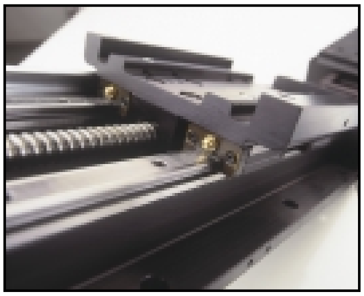
Recirculating Linear Bearings

Recirculating linear bearings are typically used in longer travel, higher speed, heavier load applications. Recirculating bearings offer smooth motion; however, the coefficient of friction is slightly higher than the non-recirculating bearings due to wiper friction. IDC uses only matched precision grade linear guideways (cumulative running parallelism of 15 linear guideway microns over 2 meters) on all recirculating bearing tables (RB4A, RB6, RC6 and RB8).



Recirculating Linear Guideway

The main advantage of using recirculating bearings is increased load capacity. Recirculating bearings are ideal for applications with heavy loads, moment loads and impact loads. Another advantage of recirculating bearings is a Positioning Table carriage that is contained within the base of the Table. Because the recirculating bearing table top does not extend beyond the base of the table, additional environmental protection can be provided by neoprene coated polyurethane bellows covers (RB4A, RB6 and RB8) or aluminum plate covers (RC6). Recirculating bearings are also ideal for high speed, high acceleration applications because they are not subject to retainer creep. Sizing recirculating bearing tables is relatively simple. Choices range from small footprint – light load (RB4A) to medium footprint – medium load (RB6 and RC6) to large footprint – heavy load (RB8). Please refer to the individual product pages for further details. Please note that the main difference between the RB6 and the RC6 is the environmental protection (RB6 – neoprene coated polyurethane bellows, RC6 – aluminum plate covers). Recirculating bearings are typically used as the building blocks for custom multi-axis systems. Please refer to the Multi-Axis System Section for further details.

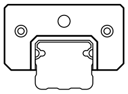


Recirculating bearings in an RC6

Applications that have angular error or straightness and flatness requirements at the limits of mechanical bearings typically use recirculating bearings.

Lubrication and Life

Recirculating bearings, when used in standard environments, should be lubricated at least every 1–2 million inches of travel (25km – 50km) with lithium soap base grease #2. Other lubricants are necessary in non-standard environments. For more information about lubrication, please contact IDC.



The bearing life is typically shorter than the ballscrew life for a Precision Positioning Table because the load carried by the bearings typically exceeds the thrust load, provided that neither the bearings nor the ballscrew becomes contaminated. To theoretically estimate the life of the bearings, it is necessary to know the peak load applied to the bearings and the dynamic load capacity of the bearings (provided for each positioning table in the individual product sections). Please note that these calculations provide the B10 life for the contact elements (the life at which 90% of all contact elements maintain geometric integrity).

Example: RB8

Dynamic Capacity = 1550 kg

Supported Load (max.) = 182 kg

Life (km) =

$$\left(\frac{\text{Dynamic Capacity}}{\text{Supported Load}}\right)^3 \text{ x } 50 = \left(\frac{1550}{182}\right)^3 \text{ x } 50 = 30885 \text{ km}$$

Note: 25 km equals approximately 1 million inches.

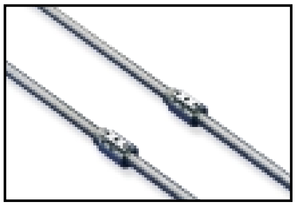
For applications with requirements beyond the capabilities of either recirculating or non-recirculating bearings, please contact IDC to discuss your application.

Technology

Drive Screws

Ballscrews

All IDC Linear Precision Tables, except the CP3, use preloaded high precision ground ballscrews. All precision table standard travel ballscrews are manufactured to a JIS C3 lead accuracy (JIS C5 for extended travel ballscrews and JIS C1 for a higher precision option). All IDC ballscrews utilize a proprietory design that provides extremely smooth, accurate, quiet motion with zero backlash and low torque. It is especially important to eliminate ballscrew backlash because this type of backlash is not highly repeatable and makes motion controller compensation very difficult.



Ballscrews

JIS Accuracy Standards

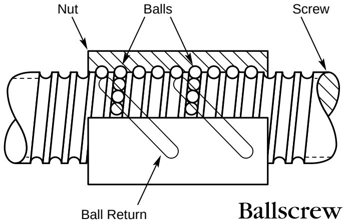
According to JIS standard 1192, C3 grade ballscrews are allowed a maximum lead error of 8 microns over any 300mm of travel and a maximum of 6 microns of lead error over any revolution (JIS C5 allows a maximum of 18 microns over any 300mm and 8 microns over any revolution). Also, the C1 grade ballscrew allows a maximum lead error of 5 microns over any 300mm of travel and a maximum of 4 microns of lead error over any revolution. The actual lead error will be less than or equal to the amount allowed by the standard; however, the actual lead error will vary over the travel of the screw. Every ballscrew is certified for lead accuracy and running torque according to international standard DIN 69051 (ISO 3408). For applications with positioning requirements that are beyond JIS C3 standards, please consider using a Linear Encoder or Performance Verification testing. Higher accuracy ballscrews (e.g. JIS C1 - 5 microns over 300mm) are also available. Please refer to these sections for further details.

Ballscrew Lead Choices

All IDC Linear Precision Tables have 2-3 ballscrew lead choices to suit a variety of applications. The maximum linear speed is given for each travel in the individual Precision Table product sections. The maximum linear speed is limited by the Dm-N value for shorter travels and critical speed for longer travels. Column loading is not typically a consideration for Precision Positioning Tables because they are used primarily for positioning. Electric Cylinders, which are used primarily for thrust, can have significant column loading issues. The Dm-N speed is set by the maximum speed of the ball bearings within the nut without skidding. The critical speed is proportional to the diameter divided by the length between the supports squared $(\sim D/L^2)$ as well as the method of support. Column loading is also proportional to the method of support and diameter raised to the 4th power divided by the length between the supports squared $(\sim D^4/L^2)$. The ballscrew lead choices are as follows:

PB4, CP8 and RB4A ...	2.5MG (0.0984 inch - 2.5mm) 5G (0.2 inch - 5.08mm) 2G (0.5 inch - 12.7mm)
HM, RB6 and RC6	5G (0.2 inch - 5.08mm) 10MG (0.3937 inch - 10mm) 20MG (0.7874 inch - 20mm)
RB8	5G (0.2 inch - 5.08mm) 10MG (0.3937 inch - 10mm) 1G (1.0 inch - 25.4mm)

Please note that increasing the system resolution by reducing the lead of the ballscrew does not make the ballscrew more accurate. All IDC ballscrews are governed by the JIS C3 lead accuracy tolerances regardless of lead. In practical application, this means that both the 5G and 1G ballscrews are allowed a maximum of 8 microns per 300mm and 6 microns per revolution.



Ballscrew

It is important to note that the system resolution will be affected by changing the ballscrew lead. For example, a servo with a 2000 line rotary encoder has an electrical resolution of 0.635 microns with the 5G ballscrew, but the electrical resolution increases to 3.175 microns with the 1G ballscrew.

Applications Information

IDC Linear Precision Tables that are driven with ballscrews can be used in a wide variety of applications. The maximum thrust allowable for contouring applications is provided for each Positioning Table in the individual product sections. All other ballscrew dependent specifications are provided in the individual product sections. Vertical applications that require back driving resistance can be accommodated by several methods. First, standard B series IDC servos can be equipped with an integral 24VDC brake (-B option). This is typically the simplest solution because the ballscrew and motor are directly coupled. Another option involves preloading the ballscrew to increase its back driving resistance. However, the increased preload will reduce system resolution and increase the required running and breakaway torque. If neither of these options is feasible, then traditional methods, such as using a leadscrew, attaching a dedicated brake directly to the ballscrew shaft, using a gearhead or counter balancing should be considered. For more information on any of these options, please contact IDC.

Lubrication and Life

Ballscrews, when used in standard environments, should be lubricated at least every 1–2 million inches of travel (25km – 50km) with lithium soap base grease #2. Other lubricants are necessary in non-standard environments. For more information on lubrication, please visit IDC's web site to download the Precision Table's manual. Ballscrews can be run at 100% duty cycle.

Because the thrust load on a ballscrew is relatively low in comparison with the load supported by the bearings in a Precision Table, the ballscrew life should greatly exceed the life of the bearings provided that the ballscrew does not become contaminated. To theoretically estimate the life of a selected ballscrew, it is necessary to know the peak thrust load and the dynamic load capacity of the ballscrew (provided for each ballscrew in the individual product sections). Please note that these calculations provide the B10 life for the rolling elements in the ballnut (the life at which 90% of all contact elements still maintain geometric integrity).

Example: RB6 — 20MG Ballscrew

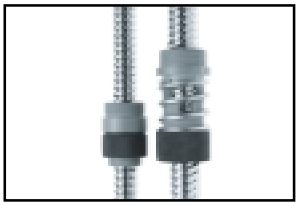
Dynamic Capacity = 136 kg
Thrust Load (max.) = 25 kg
Life (km) =

$$\left(\frac{\text{Dynamic Capacity}}{\text{Thrust Load}}\right)^3 \text{x } 250 = \left(\frac{136}{25}\right)^3 \text{x } 250 = 40247 \text{ km}$$

All drive screws are supported by one preloaded 2 row angular contact bearing and one deep groove bearing in a fixed-simple configuration, except for the CP3 and CP8, which are supported in a fixed-free configuration.

Leadscrews

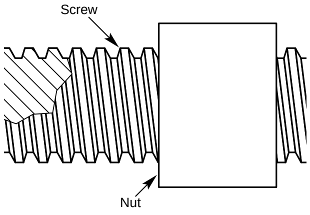
Precision rolled leadscrews are available on the CP3, CP8 and RB4A Precision Tables. Leadscrews are the standard drive screw for all CP3 Positioning Tables. In comparison with IDC's standard ballscrews, the main disadvantages of leadscrews are their lower accuracy and limited duty cycle (60% or less). Please note that the duty cycle is the percentage of Move Time divided by the Total Cycle Time for a 10 minute period that represents the worst case motion sequence. Leadscrews are typically used in applications where cost or resistance to back driving is more important than accuracy. The efficiency and linear speed of leadscrews are also limited in comparison to ballscrews. Leadscrews are also not well suited for contouring applications. Special high precision ground leadscrews are also available upon request. Please contact IDC for further details.


Leadscrews

Leadscrew Choices

CP3	40A (0.025 inch - 0.635mm) 10A (0.1 inch - 2.54mm) 5A (0.2 inch - 5.08mm)
CP8 and RB4A	10A (0.1 inch - 2.54mm) 5A (0.2 inch - 5.08mm)

IDC's standard leadscrews have a nominal lead accuracy of 0.0003 inches per inch (90 microns per 300mm). Leadscrews share many of the same application constraints with ballscrews (critical speed, etc.). Typical leadscrew life is somewhat harder to estimate because both the load and speed will cause the acetal nut to wear. For more information on leadscrews, please refer to the individual product sections or contact IDC to receive a copy of the Precision Table's manual.



Leadscrew

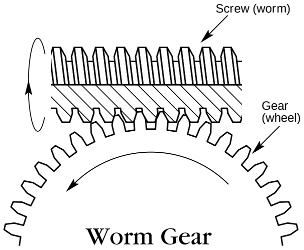
Note: IDC Precision Tables can also be used in slide applications. Please indicate "XDS" in the drive screw field.

Worm Gears

The RG Rotary Positioning Tables use a precision worm gear (AGMA class 10). These gears are matched and lapped to ensure smooth, precise motion with minimal backlash. These AGMA class 10 gears are designed for positioning applications only. They are not designed for high torque or high inertia applications. The maximum input torque for RG Positioning Tables is limited to 75 oz-in.

Gear Ratios

The RG Rotary Tables have 3 gear reductions available: 180:1, 90:1, 45:1.



Worm Gear

Lubrication and Life

The worm gear should be lubricated at least every 1-2 million reversing cycles with lithium soap base grease #1. Determining worm gear life is as difficult as determining the life for a leadscrew because both speed and torque strongly affect the wear of the gears. For more information on worm gears, please refer to the RG section or visit IDC's web site to review the Precision Table's manual.

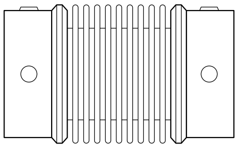
Special drive screws for all IDC precision tables are available upon request. Please contact IDC to discuss your application.

Coupling Choices

There are 3 coupling choices offered for each IDC Precision Positioning Table.

Bellows Couplings

Materials:
Coupling — Stainless Steel
Hubs — Aluminum Alloy



Bellows Coupling

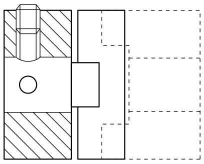
Bellows couplings are the most torsionally rigid.

They are ideal high speed and high torque applications that require quick settling times.

Bellows couplings are typically used in servo applications and are part of the basic IDC servo configuration.

Oldham Couplings

Materials:
Hubs — Aluminum Alloy
Disc — Acetal



Oldham Coupling

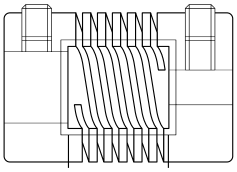
Oldham couplings also exhibit high torsional rigidity.

Their 3 piece design is ideal for vibration damping. Oldham couplings can be used in many high performance applications.

Oldham couplings are typically used in stepper applications and are part of the basic IDC stepper configuration.

Stainless Steel Beam Couplings

Materials:
Coupling — Stainless Steel



Beam Coupling

Stainless Steel Beam Couplings are the least torsionally rigid.

They are typically used in low torque applications where cost is more important than quick settling and vibration damping.

Note: Customer Supplied Couplings can also be accomodated by designating "XC" in the coupling field.

Coupling Technical Considerations

Because IDC installs precision motor mounts, typical coupling considerations, such as angular misalignment and axial compliance, are not critical issues. However, coupling selection can affect positioning performance in several major areas. Please note that the stiffness of a coupling is the inverse of the compliance of a coupling.

Torsional Compliance

Torsional compliance (a.k.a. Wind Up, Twist) can be an important source of positional error. First, any coupling, when subjected to a torsional load, will twist (deflect). The amount of angular deflection, for a given torque, is the torsional compliance. Second, in comparison with the drive screw and the motor shaft, the coupling is typically the most torsionally compliant component in the drive train. Therefore selecting a sufficiently stiff coupling is critical for optimum positioning results. Finally, couplings can be a significant source of system hysteresis, especially when they are highly torsionally compliant.

Positional Errors

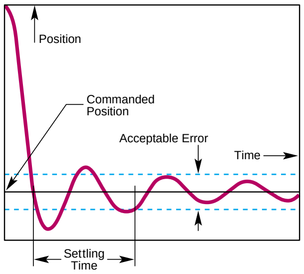
As previously mentioned, when a coupling is subjected to a torque, it will deflect in proportion to its torsional compliance. A highly compliant coupling will deflect more than a stiff coupling. The amount of angular deflection will translate into positional error proportional to the lead of the drive screw. Therefore, it is extremely important to minimize this potential source of positional error by selecting a sufficiently stiff coupling.

Example:
Torque = 120 oz-in
Coupling Compliance = 0.00142 degrees per oz-in
Lead = 0.2 inches per revolution
Positional Error = Torque (oz-in) x Coupling Compliance (degrees per oz-in) x (1/360) x Screw Lead (mm or in. per rev.)
Positional Error = (120 oz-in) x (0.00142 degrees per oz-in) x (1/360) x (0.2 inches per rev.)
= 0.000095 inches

Natural Frequency (Settling Time)

In addition to the critical speed issues associated with the drive screw of a positioning system, the natural frequency of the coupling must also be examined. Highly torsionally compliant couplings, when used in positioning systems with high inertia or high system dynamics, will have longer settling times and exagerated overshoot. Typically, it is desirable to have the natural frequency of the coupling higher than 600 Hz. The natural frequency of the coupling is proportional to the square root of the product of the coupling torsional stiffness and the sum of the inverses of the load and motor inertia. For applications with special positioning requirements, including settling and overshoot, please consider ordering one of our Performance Verification tests.

Settling Time



Example:

Motor Inertia = 5.5 x 10^{-3} ozins^2

Load Inertia = 58 x 10^{-3} ozins^2

Coupling Compliance = 0.000769 degrees per oz-in

Coupling Stiffness = 1300 oz-in per degree

Natural Frequency =

$$(0.159)\ \text{x}\ \sqrt{\left(\left(\frac{1}{\text{Motor Inertia}}\right)+\left(\frac{1}{\text{Load Inertia}}\right)\right)\ \text{x}\ \left(\begin{matrix}\text{Coupling}\\ \text{Stiffness}\end{matrix}\right)\ \text{x}\ \left(57.296\right)}$$

Natural Frequency =

$$(0.159)\ \text{x}\ \sqrt{\left(\left(\frac{1}{5.5\ \text{x}\ 10^{-3}}\right)+\left(\frac{1}{58\ \text{x}\ 10^{-3}}\right)\right)\ \text{x}\ \left(1300\right)\ \text{x}\ \left(57.296\right)} = 612.2\ \text{Hz}$$

Bellows Coupling Choices

Table	Model	Motor I.D. (inches)	Screw I.D. (inches)	Nominal O.D. (inches)	Length (inches)	Inertia ozins^2 x 10^{-3}	Compliance degree/oz-in	Max. Torque oz-in
CP3	BE4	0.25	0.1875	0.5	0.996	0.057	0.00333	158
CP3	BE5	0.3125	0.1875	0.75	1.29	0.343	0.00115	210
HM, PB4, CP8, RB4A, RB6, RC6	BE4	0.25	0.25	0.75	1.29	0.343	0.00115	210
HM, PB4, CP8, RB4A, RB6, RC6	BE5	0.3125	0.25	0.75	1.29	0.343	0.00115	210
HM, RB6, RC6	BE6	0.375	0.25	0.75	1.29	0.343	0.00115	210
RB8	BE6	0.375	0.375	1	1.48	1.586	0.00056	420
RB8	BE8	0.5	0.375	1	1.48	1.586	0.00056	420
RB8	BE10	0.625	0.375	1	1.48	1.586	0.00056	420

Oldham Coupling Choices

Table	Model	Motor I.D. (inches)	Screw I.D. (inches)	Nominal O.D. (inches)	Length (inches)	Inertia ozins^2 x 10^{-3}	Compliance degree/oz-in	Max. Torque oz-in
CP3	OM5	0.1969	0.1875	0.75	0.87	0.279	0.0035	185
RG, CP3	OE4	0.25	0.1875	0.75	0.87	0.279	0.0035	185
HM, PB4, CP8, RB4A, RB6, RC6	OE4	0.25	0.25	0.75	0.87	0.279	0.0035	185
HM, PB4, CP8, RB4A, RB6, RC6	OE5	0.3125	0.25	0.75	0.87	0.279	0.0035	185
HM, RB6, RC6	OE6	0.375	0.25	1	1.12	1.293	0.002	260
RB8	OE6	0.375	0.375	1.31	1.89	5.872	0.000688	385
RB8	OE8	0.5	0.375	1.31	1.89	5.872	0.000688	385
RB8	OE10	0.625	0.375	1.31	1.89	5.872	0.000688	385

Stainless Steel Beam Coupling Choices

Table	Model	Motor I.D. (inches)	Screw I.D. (inches)	Nominal O.D. (inches)	Length (inches)	Inertia ozins^2 x 10^{-3}	Compliance degree/oz-in	Max. Torque oz-in
CP3	SM5	0.1969	0.1875	0.75	0.9	0.288	0.01563	70
RG, CP3	SE4	0.25	0.1875	0.75	0.9	0.288	0.01563	70
RG, CP3	SE5	0.3125	0.1875	0.875	1.06	0.656	0.00938	85
HM, PB4, CP8, RB4A, RB6, RC6	SE4	0.25	0.25	0.875	1.06	0.656	0.00938	85
HM, PB4, CP8, RB4A, RB6, RC6	SE5	0.3125	0.25	0.875	1.06	0.656	0.00938	85
HM, RB6, RC6	SE6	0.375	0.25	1	1.25	1.328	0.0075	115
RB8	SE6	0.375	0.375	1	1.25	1.328	0.0075	115
RB8	SE8	0.5	0.375	1.125	1.5	2.496	0.0057	140
RB8	SE10	0.625	0.375	1.5	2.62	13.92	0.00375	160

Note: All IDC couplings are designed for 10^8 reversing cycles at 80% of maximum torque. Please derate for high torque reversing loads.

Motors

Each Precision Positioning Table has a basic Stepper or Servo motor configuration that was chosen for most typical applications. These motors may not be appropriate for every possible application. Therefore, it is very important to verify the motor sizing requirements for your application. Please refer to the Stepper, Servo and Engineering sections, as well as the Selection Checklist and calculation reference, for further information on motor sizing, performance and tuning.

Performance Motors

All Precision Tables have a P series Performance Stepper as part of the basic Stepper configuration. These motors were specifically chosen for their high torque output and low inertia. If a specific Stepper configuration (T, V, EM, etc.) is required, it will be shipped with the IDC connector specified in the Stepper section. Each individual product section lists the different Steppers that can used with each Precision Table.

The basic Servo configurations use the BN series motors because they provide sufficient torque with very low cogging. The standard B series can also be used, especially in applications where higher resolution or an integral brake (-B) is necessary. The BN motors are shipped with an IDC connector. The B series motors are shipped with a quick disconnect. Each individual product section lists the different servos that can be used with each Precision Table. The importance of proper servo tuning cannot be exaggerated.

Using larger or higher torque motors requires IDC approval; otherwise, the warranty will be voided.

It is important to note that both servo and stepper motors introduce a significant amount of hysteresis, which limits its bi-directional repeatability and accuracy. Motors are also a significant source of heat, which can cause positional errors due to the thermal expansion of the mechanical components.

Gearmotors

Gearmotors are sometimes used to increase the mechanical resolution and reduce the speed or increase torque requirements of a positioning system. However, there are important consequences associated with using a gearmotor. First, every gear reduction introduces backlash and additional inertia into the motion system. Fortunately, high quality gear reductions have backlash that is highly repeatable, and some motion controllers can compensate for this error. Therefore, it is very important to use the Performance series Gearmotors instead of the Value series. The low backlash option (-LB) is also recommended. Please refer to the Gearmotor section for further details. Another important consequence of using a gearmotor is the introduction of periodic error into the positioning system. Depending on an application requirements, this may be a significant problem. If periodic error is a concern, consider ordering Performance Verification testing to map this error because some motion controllers can compensate for this. Finally, it is important to note that Gearmotors typically have larger shafts than standard NEMA motors. A special coupling or motor mount may be necessary. Please refer to the specific product sections and coupling section for further details. If special couplings or motor mounts are required, please contact IDC. To be fully integrated into the Precision Table, the gearmotor must be included in the Precision Table part number. For right angle Gearmotors, the standard orientation for the motor is up (vertical). For further orientations, please contact IDC.

Example:
RB6-12-5G-BE8-G23-PI-BN23-0030-LB-LI3-E0-CV1

Non-IDC Motors

IDC Precision Positioning Tables can also be used with non-IDC motors. If a non-IDC motor is required, there are 2 options. First, standard NEMA dimensioned motors can be easily accommodated because the standard table configuration includes a true NEMA motor mount. This is specified in the Motor field as follows:

CP3	NEMA 17	X17n
RG, HM, CP3, PB4, CP8, RB4A, RB6 and RC6	NEMA 23	X23n
RB6, RC6 and RB8	NEMA 34	X34n

n = X Customer Supplied and Mounted
n = C Customer Supplied and IDC Mounted

Because most current "NEMA" motors actually have shafts that are larger than the true NEMA standard, it is important to carefully select the correct coupling size.

IDC Precision Tables can also be used with completely non-NEMA motors. However, these motors will require special motor mounts and couplings. Therefore, it is necessary to have all application and motor information reviewed by IDC prior to placing any orders. Please refer to the Product Selection Worksheet for non-standard applications.

Manually driven applications can also be accommodated by utilizing a hand wheel or micrometer instead of a motor. These types of applications require an application review from IDC. Please contact IDC if your application requires these types of drives.

Limit Switches

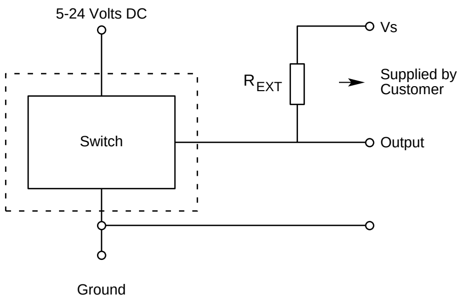
All IDC Linear Precision Positioning Tables have 3 position Hall Effect limit switches included as part of their basic configuration. The distance between the End of Travel limits defines the nominal travel of each Precision Table (this also includes sufficient space for bellows covers). This method ensures that the user will be able to use the entire travel without having to make special allowances for limit switches. The End of Travel limits are nominally located 1/2 inch in from the hard stops. The Home switch is normally located 1 inch in from the Negative limit (located on the motor end of the Precision Table). Please refer to the individual product sections for further information on limit switch locations.

The RG Rotary Table has a single position Hall Effect Home switch included as part of the basic configuration. The standard orientation when the Home switch is activated is shown below. Please refer to the RG product section for further details.

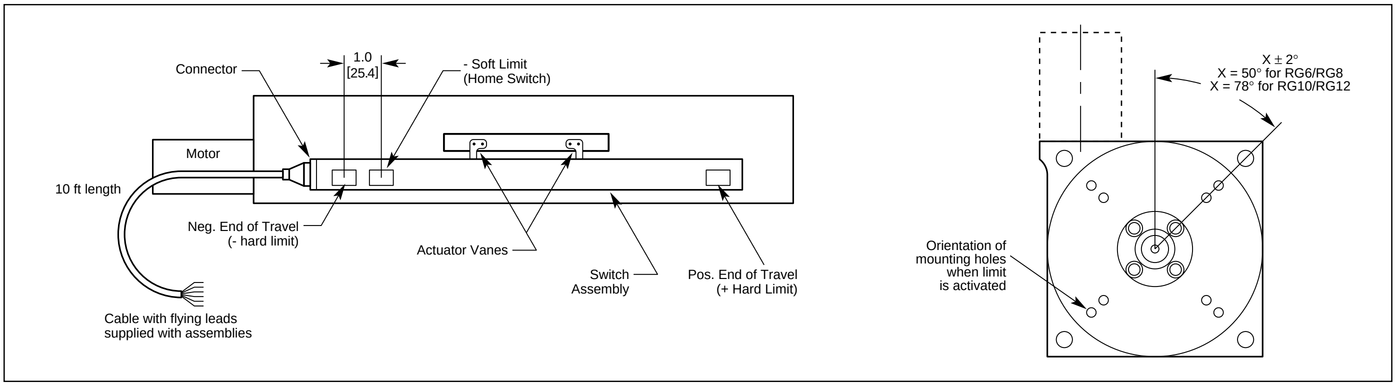
All IDC limit switches are normally closed, current sinking NPN type switches. When the switch is activated, the output voltage transitions from Low to High. Special limit switches (PNP, optical, proximity, etc.) can also be used with IDC Precision Tables. Please contact IDC to discuss your application requirements.

All recirculating bearing and rotary Precision Tables (RG, RB4A, RB6, RC6 and RB8) have internally mounted limit switches. The locations of these switches cannot be adjusted. All of these switches terminate in a 9 pin AMP connector except the RB4A and RC6, which terminate in a 9 pin D shell connector. A 10 foot high flex cable is supplied that terminates in the mating connector at one end and flying leads at the other end. Please refer to the following drawings for wiring information.

Limit Switch Circuits



For 24 Volt Circuit: Vs = 24 VDC; R_{EXT} = 1380 Ohm
For 12 Volt Circuit: Vs = 12 VDC; R_{EXT} = 680 Ohm
For 5 Volt Circuit: Vs = 5 VDC; R_{EXT} = 270 Ohm (TTL)



Standard Configurations

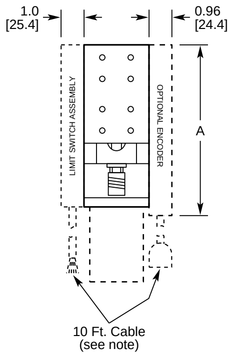
All non-recirculating bearing Precision Tables (HM, CP3, PB4 and CP8) have externally mounted limit switches. Please refer to the drawings on the next page. The location of the non-magnetic activation vanes can be adjusted on all non-recirculating bearing Precision Tables. These switches are fixed with a hot melt adhesive, protected by black anodized aluminum and terminate in a 10 foot high flex cable with flying leads. Please refer to the following wiring drawings.

Wiring Information

D Type Conn Pins	Amp Conn Pins	Cable Wire Color	Function
1	7	Yellow	– Limit Sensor Output
2	8	Black	Ground
3	3	—	Drain (Shield)
4	4	Green	Home Sensor Output
5	1	—	None
6	5	Red	+ Voltage Input
7	2	Brown	None
9	6	Orange	+ Limit Sensor Output

Physical Switch Layout

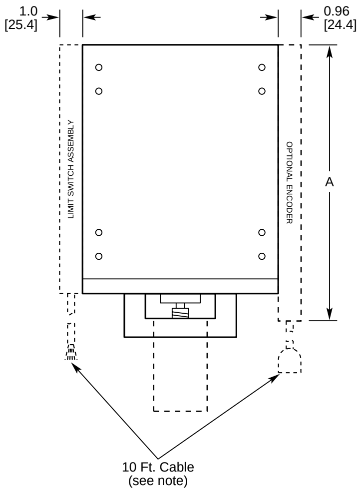
CP3



Stroke	Dim A
1	6.10 [154.9]
2	6.89 [175.0]
3	7.67 [194.8]
4	8.85 [224.8]
5	10.04 [255.0]
6	10.82 [274.8]

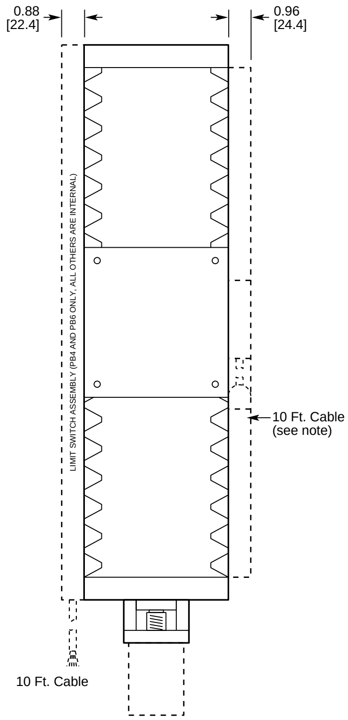
NOTE:
Encoder scale (Dim A) moves with table travel. Allow space as necessary.

CP8

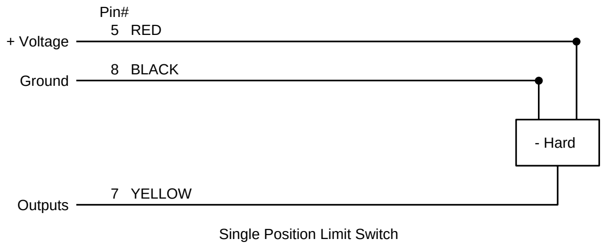


Stroke	Dim A
5	10.04 [255.0]
7	12.79 [324.9]
9	14.76 [374.9]
12	16.73 [424.9]

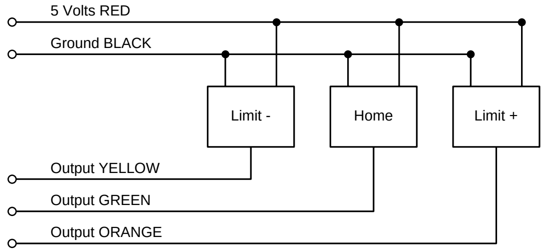
RB4A, PB4, RB6, PB6, RB8, RC6



RG Rotary (H1) Wiring Diagram



Standard 3 Position Limit Switches



Make It An IDeal System
See Intro Pages 6 & 7

All limit switch configurations, when ordered as part of an IDeal System, will arrive prewired and tested. All linear IDC Precision Tables can also be shipped with an optional 2 position limit switch (L_2 - End of Travel limits) or without limits (L0 or H0 for the RG rotary table). Please refer to the individual product sections for further details.

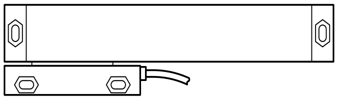
Application Notes

Limit switches are repeatable to 50 microns (0.002 inches) for Linear Precision Tables and 2 degrees for the RG Rotary Table. However, positioning is not the primary function of limit switches. The End of Travel limits are used to signal the control to begin deceleration due to the proximity of the hard stops. The Home switch is used to provide a nominal reference point in conjunction with the controller and encoder for starting and stopping motion cycles. It is important to note that End of Travel limit switches do not guarantee over travel protection from hard stop collisions. It is the responsibility of the user to verify that there will be sufficient stopping distance, based on the momentum of the carriage (mass x velocity) to avoid a hard stop collision. Highly dynamic applications may require stopping distance. Please contact IDC if your application will require additional space for deceleration.

Encoders

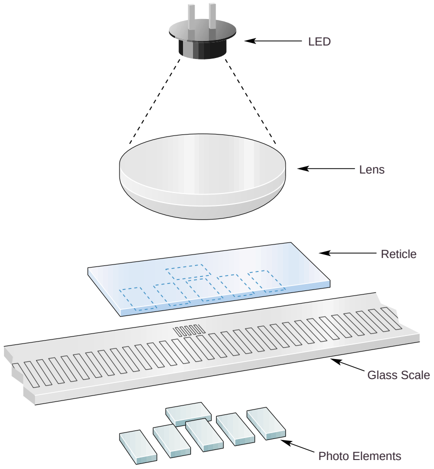
Linear Encoders

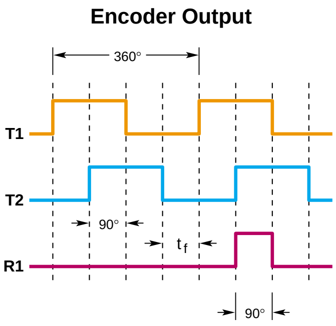
Linear encoders can be added to all linear Precision Tables to improve positioning performance. Repeatabilities up to one encoder count may be possible depending on application conditions. Because the linear encoder read head is directly attached to the carriage, a motion controller can benefit from directly measuring the carriage position. Directly measuring the carriage position can improve positioning results by compensating for the positional errors caused by thermal expansion of the drive screw, lost rotary encoder counts, mechanical backlash and other system hysteresis (e.g. coupling wind up). Please note that most positioning systems using both rotary and linear encoders typically need at least 4 times more rotary encoder pulses than linear encoder pulses to avoid linear encoder dither. This 4:1 rule of thumb also applies when comparing step motor and linear encoder resolutions.



Standard Options

All IDC linear positioning tables have the option of adding a 1 micron resolution (EM1) or 2 micron resolution (EM2) linear encoder. Each linear encoder contains a precision etched glass scale packaged within a protective aluminum housing with a photoelectric read head. The glass scale has protective seals over the length of travel (IP53). All linear encoders are precisely attached to the Positioning Tables to minimize misalignment. Encoders are supplied with a 3 meter high flex cable that terminates in a 12 pin DIN connector. The mating connector is also supplied. The reference pulse is nominally located at the center of table travel.

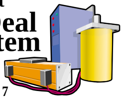




Linear Encoder Wiring — 12 Pin DIN Connector

Pin No.	Wire Color	Signal
A	Shield	Earth GND
B	White	GND (OV)
C	Green	CH A+ (TI+)
D	Yellow	CH A– (TI–)
E	Pink	CH B+ (T2+)
F	White (opt.)	GND (OV)
G	Brown	RI+
H	Grey	RI–
J	White (opt.)	GND (OV)
K	Black	+5V
L	Red	CH B– (T2–)
M	Black (opt.)	+5V

All linear encoders provide a differential square wave output with a reference pulse (RS-422) that is compatible with most motion controllers. A + 5VDC (± 5%), 150 ma power supply is required. The environmental capabilities of the linear encoders exceed the capabilities of the Precision Tables that they are attached to. A calibration certificate is shipped with all standard linear encoders. All linear encoders, when ordered as part of an IDeal system, will arrive prewired and tested.



Encoder Specifications

	EM1	EM2
Resolution (microns)	1	2
Scale Accuracy (microns per meter)	±5	±5
Grating Pitch (microns)	20	40
Output Frequency (kHz)	100	100
Peak Speed (meters/sec)	1	2
Continuous Speed (meters/sec)	1	1
Operating Temperature Range (Storage 70°C)	0°C to 50°C 32°F to 122°F	

Please contact IDC if a non-standard linear encoder is required for your application.

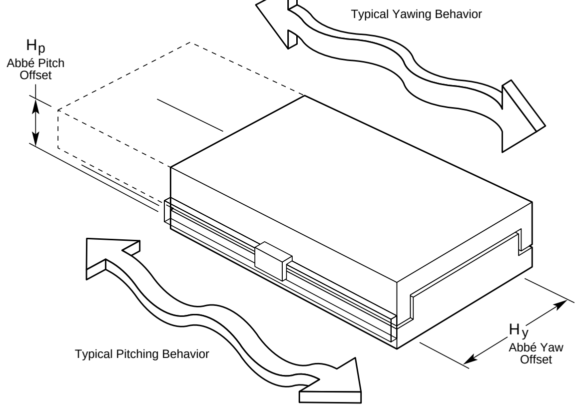
Application Notes

It is important to note that a linear encoder does not have the ability to correct all the positioning errors of a motion system. First, adding a linear encoder to a positioning system does not ensure that a positioning system will actually be able to make incremental movements equal to the resolution of the encoder (e.g. adding a 1 micron (EM1) linear encoder to an RB6 Table does not mean that the RB6 can now make 1 micron incremental movements). The positioning system resolution is determined by the system static friction (stiction), the load inertia, the mechanical compliance and the torque of the rotary motor. The smallest incremental movement (system resolution) must be measured for each specific positioning system based on application conditions. The resolution of the linear encoder only provides the smallest incremental movement that can be detected (electrical resolution). For more information on measuring the smallest incremental movement of a positioning system, please refer to the Performance Verification and Testing section.

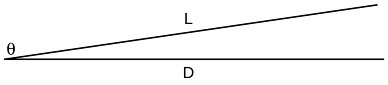
In addition to system resolution, it must also be noted that adding a linear encoder to a positioning system does not increase the accuracy of the system to the resolution of the linear encoder (e.g. adding a 1 micron (EM1) linear encoder to a CP8 Table does not mean that the CP8 now has an accuracy of 1 micron). To understand why this is true, it is important to remember that a linear encoder measures the position of the read head relative to the glass scale. A linear encoder cannot compensate for the following types of errors:

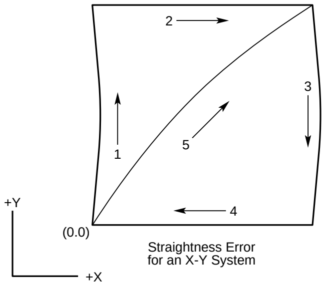
- **Cosine Errors** caused by misalignment between the linear encoder and the direction of travel
- **Angular Errors** in roll, pitch and yaw caused by the structure and bearings
- **Straightness and Flatness Errors** caused by the structure and bearings
- **Abbe Errors** caused by the offset distance between the point of measurement (read head) and the carriage top
- **Orthogonality Errors** caused by imperfect perpendicularity between 2 axes
- **Stack Up Errors** caused by the transmission of angular errors from a supporting axis to the supported axis
- **Contouring Errors** in material removal or marking applications. Permanent errors will occur before the linear encoder can compensate for them.

Abbé Offset Errors

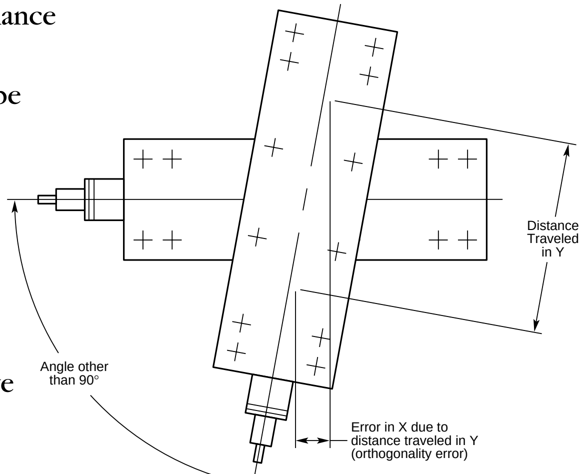


Cosine Errors





Straightness Error for an X-Y System



Orthogonality Error

To better understand the true positioning performance limitations of a motion system, actual performance testing is necessary. Please refer to the Performance Verification section for further details. Most motion controllers (with or without linear encoders) can compensate for most positioning errors provided that the error data is known.

Please note that high resolution encoders may not be well suited for high speed applications depending on the bandwidth limitations of the encoder or the motion controller. The top speeds for each linear encoder are listed on the previous page. Improperly shielded or grounded encoders can cause serious controller problems.

Rotary Encoders for Motors

All IDC servos (BN and B series) have integral rotary encoders. IDC Steppers do not have rotary encoders as part of their standard configuration; however, a rotary encoder can be added to a Stepper with the -EM or -EMK option. Please refer to the Stepper section for further details.

Rotary Encoders for RG Rotary Positioning Tables

For applications requiring rotary positioning performance beyond the standard specifications of an RGC or RGP Rotary Precision Table, a high resolution rotary encoder can be mounted directly to the base of the RG Table. This option requires a substantially taller base. Please contact IDC to discuss your application.

Technology

Environment

All IDC Precision Tables are designed for use in industrial automation applications. They can be used in most typical production environments (a.k.a. General Industrial). Non-recirculating bearing and rotary Precision Tables (RG, HM, CP3 and CP8) should only be used in relatively clean environments because they do not have any special means of protection (e.g. bellows covers). Recirculating bearing Precision Tables (RB4, RB6 and RB8) and the PB4 have neoprene coated polyurethane bellows covers included in their basic configuration. These covers provide a significant degree of protection against airborne particulates and liquid mists (nominal IP53). The neoprene coating enhances the bellows resistance to moisture. The RC6 Precision Table has clear anodized Aluminum plate covers (nominal IP30) that provide protection against damage from relatively large or heavy objects (e.g. dropped tools or fasteners). All recirculating bearing Precision Tables (RB4, RB6, RC6 and RB8) have linear guideway bearings with wiper seals, which provide additional protection against contamination.

Clean Room Applications

Clean room specifications and standards are typically defined by US Federal Standard 209(E) and ISO 14644-1. Standard IDC Precision Tables can be used in applications with clean room requirements up to Class 1000. For applications that have more stringent clean room requirements, IDC has a standard Class 100 clean room preparation. This preparation involves the following modifications:

- Removing all seals, bellows, wipers and particle generating components
- Using only non-oxide or stainless steel hardware
- Using clean room compatible lubricants

Experience has shown that these modifications will provide conformance with Class 100 clean room standards.

Class 100 clean room preparation is ordered as a separate line item adder for each axis requiring preparation. A wipe down prior to installation is recommended.

Example:

CP8R-5-5G-OE4-P21-LX3-E0	2
CLEAN 100	2
CP8 XYP	1

For clean room applications with higher requirements (e.g. Class 10), please contact IDC.

Vacuum Applications

Standard IDC Precision Tables are designed for use in atmospheric pressures ranging from 760 torr to 250 torr. Standard Precision Tables can be used in vacuum environments as severe as 10^{-3} torr; however, there may be significant outgassing, which could potentially contaminate the vacuum environment. For applications with vacuum requirements ranging from 10^{-3} torr to 10^{-7} torr, IDC has a standard vacuum preparation to minimize outgassing. This preparation involves the following modifications:

- Eliminating casted materials
- Removing paint from all surfaces, and vapor degreasing all surfaces, components, hardware, etc.
- Ventilating all blind holes and using ventilated fasteners
- Nickel plating all Aluminum structural components or using unplated materials
- Replacing PVC insulated cables and wires with Teflon or Kapton insulated wiring
- Using vacuum compatible lubricants
- Eliminating all sulfur-based cutting fluids during manufacturing

Experience has shown that these modifications will minimize outgassing to a level that is compatible with use in 10^{-7} torr vacuum environments. Please note that a high temperature bake out to remove low volatility outgassing should not be attempted on any Precision Table with electronic components (limit switches, encoders, etc.) due to their limited temperature range. Vacuum preparation is ordered as a separate line item adder for each axis requiring preparation. A wipe down prior to installation is recommended.

Please note that vacuum environments are not well suited for heat dissipation (no convection). This may limit aggressive move profiles.

Example:

RB6-18-5G-BE4-BN23-LI3-E0-CV0	2
VACUUM	2
RB6 XYP	1

For vacuum applications with more stringent requirements, please contact IDC.

Extreme Temperatures

Standard IDC Precision Tables are designed for use in typical ambient temperatures of 20 C ± 15 C (68 F ± 27 F).

Most extreme temperature applications (hot or cold) can also be accommodated adjusting preloads and clearances, using specialty lubricants, etc. Certain components may have to be substituted depending on their thermal limitations. Please note that the positioning performance of all Precision Tables will be strongly affected by extreme deviations from their normal temperature range. For all applications with extreme temperature requirements, please contact IDC.

Radiation and Magnetic Fields

Standard IDC Positioning Tables are not specifically designed for use in radioactive environments. However, general exposure to alpha and beta particles poses little threat to standard Precision Tables. Gamma and Xray radiation are significantly more damaging. Xray and gamma rays can degrade lubricants, create electrical noise problems and prematurely age components. Please contact IDC if radiation exposure is significant in your application.

All standard IDC Precision Tables can be used in applications requiring minimal magnetic field emission from the Precision Table. In general, the Hall Effect limit switches will have to be eliminated or replaced with optical or mechanical limit switches. Please contact IDC if this type of modification is necessary in your application.

Wash Down and Corrosive Environments

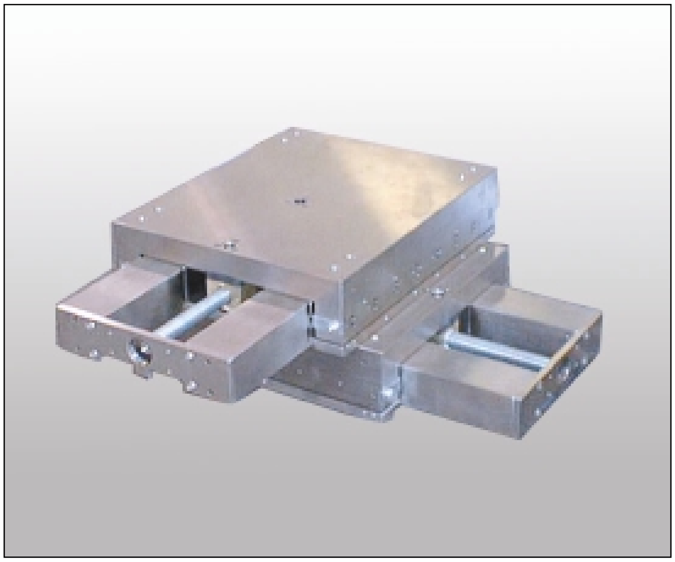
Wash down environments are common in certain types of medical, pharmaceutical, food processing and packaging applications. Standard IDC Precision Tables are not specifically designed for this type of harsh environment. In general, special stainless steel components would be substituted for standard steel components (e.g. ballscrews, linear guideways, etc.). A Nickel plated aluminum or stainless steel structure may also be necessary. If your application requires a wash down environment, please contact IDC.

Standard IDC Precision Tables are also not designed to operate in highly corrosive environments (e.g. acidic, basic, etc.). Modifications similar to those required in a wash down environment may be necessary. Please contact IDC to discuss your application if a corrosive environment is required.

Applications with Particulates and Moisture

Standard IDC Precision Tables are not designed for excessively dirty or wet applications. Applications that generate excessive particulates, especially particulates such as metal chips or grinding dust, can rapidly contaminate the mechanical components (e.g. ballscrews and bearings) and significantly shorten the life of the Positioning Table. Excessively wet applications (e.g. water, cutting fluids, etc.) will cause the steel mechanical components (ballscrews, bearings, etc.) to rust and significantly shorten the life of the Positioning Table.

Recirculating bearing Tables (RB4, RB6, and RB8) and the PB4 have neoprene bellows covers as part of their basic configuration. As previously stated, these covers provide a nominal IP53 environmental protection. However, experience has shown that this level of protection is not adequate for the harsh environmental conditions described in the preceding paragraph. For applications requiring protection against damaging particulates, special way covers can be added to provide additional protection against contamination. Applications with excessively wet environments will require modifications similar to those described in the Wash Down section. Please contact IDC to discuss your application if these types of modifications are necessary.

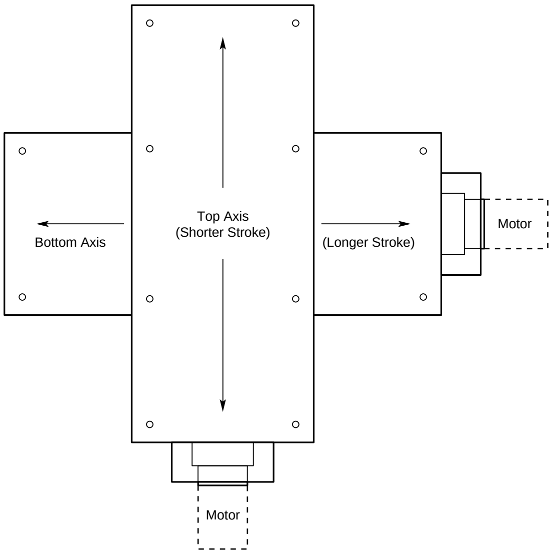


Custom CP8 table for 10^{-7} torr vacuum wafer handling application.

Multi-Axis Assemblies and Custom Systems

Multi-Axis Configurations

All IDC Precision Tables are specified as single axis Positioning Tables. Every IDC Precision Table can be configured into a standard X-Y assembly by ordering the XYP Precision Assembly option. The standard orientation is shown below.



Example:

CP8R-9-5G-BE4-BN21-LX3-E0	1
CP8R-5-5G-BE4-BN21-LX3-E0	1
CP8 XYP	1

Please note that the longer, bottom axis is ordered first.

Any Precision Table, except the CP3, can be mounted to itself directly in a standard XYP assembly without a mounting plate. A standard CP3 XYP assembly requires a mounting plate that adds 0.38 inches (9.65mm) to the overall height of the assembly. The standard XYP assembly, except the CP3, is dowel pinned. Please refer to the individual product sections for specific orthogonality tolerances.

XYP Precision Assembly Applications Considerations

The bottom axis supports the top axis in a standard XYP assembly. This has several application consequences. First, the bottom axis must be able to carry the weight of the top axis as well as the application payload. Additional moment loads may also be generated by the location of the carriage on the top axis. Second, the bottom axis must be able to handle the dynamic forces and moments generated by the motion of the top axis. Please refer to the individual product sections for specific loading limitations.

It is also important to note that there are positioning consequences as well as loading related consequences. A standard XYP assembly has a maximum orthogonality tolerance. This represents the maximum deviation from perpendicularity that is allowed. This could potentially introduce some positioning error. Please refer to the Performance Verification section for additional information on orthogonality verification. The second major positioning consequence relates to stack up error. This occurs because the angular errors of the bottom axis are transmitted to the top axis. The total angular error of the standard XYP assembly is the combination of the angular errors inherent to the top axis and the stack up of angular errors that are transmitted to the top axis from the bottom axis. The worst case estimate of the total angular error is the sum of the angular errors of each axis involved. However, the total amount of error will vary over the travel of both axes. The total angular error of the XYP assembly must be mapped to understand its variation. Please refer to the Performance Verification section for additional information on angular error mapping.

Carriage to Carriage XYC Assembly Options for the RC6

The RC6 Precision Tables can be configured in an X-Y assembly with carriage to carriage mounting. Unlike the standard XYP assembly, the XYC assembly is not dowel pinned and cannot be repinned. Also, please refer to the Application Considerations above.

Example:

RC6-18-5G-BE4-BN23-LI3-E0-CV1	2
RC6 XYC	1

Rotary XYP Assembly Options for the RG-6 and RG-8

The base of a RG-6 and RG-8 Rotary Precision Tables mounts directly to the carriage of RB6 and RC6 Positioning Tables. This provides a standard way to solve X-Theta or X-Y-Theta applications. Please note that the same XYP Application considerations apply to Rotary XYP assemblies (weight, dynamic forces, orthogonality and stack up errors). The standard orientation is shown below.

Example X-Theta:

RB6-12-5G-OE4-P22-LI3-E0-CV1	1
RGC-8-180-OE4-P21-H1	1
RG/RB6 XYP	1

Example X-Y-Theta:

RC6-18-5G-OE4-BN23-LI3-E0-CV1	2
RC6 XYP	1
RGC-6-180-OE4-BN21-H1	1
RG/RB6 XYP	1

Non-standard X-Y Assemblies and Vertical "Z Axis" Assemblies

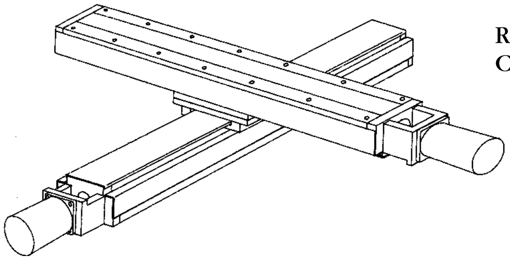
All other IDC Precision Tables can be mounted together in a non-standard X-Y assembly that may require an additional mounting plate or special holes (provided that the axis combination makes logical sense). Please contact IDC to discuss your application if you require a non-standard X-Y assembly.

IDC Precision Tables can also be used in vertical applications and assemblies (X-Z, X-Y-Z, etc.). However, the "Z" brackets that are used to configure these systems are not offered as standard assemblies due to the wide range of loading, deflection and accuracy issues involved. If your application requires a vertical ("Z") axis, please contact IDC. Some typical non-standard assemblies are shown here and on the next page.

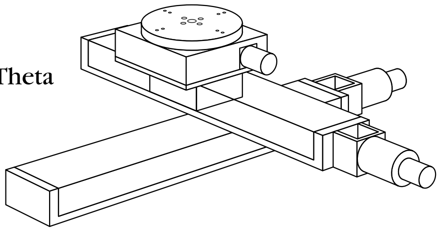
Special Products and Custom Systems

IDC can manufacture a wide variety of high precision special products and custom systems. Some special requests may be relatively simple, such as a special travel length or non-standard motor mount. Others may require significantly more engineering. Please note that standard lead-times and costs do not apply to special products. Please contact IDC to discuss your special application.

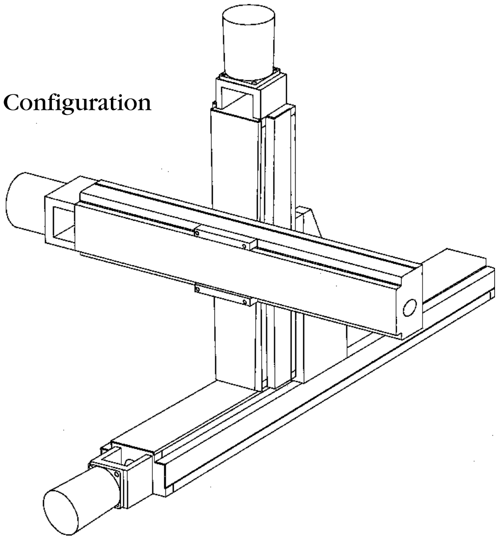
IDC also has extensive experience building completely custom positioning systems for a wide range of industries and applications. Some examples of recent custom system applications are shown on the next page. Please contact IDC to discuss your custom system needs.



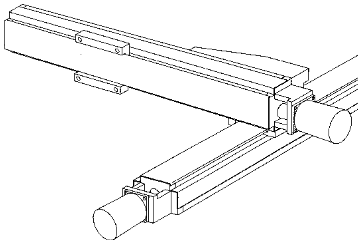
RC6 Carriage to Carriage XYC



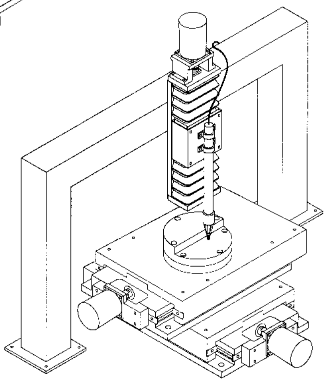
RB6/RG6 X-Y-Theta Assembly



X-Z-Y Configuration



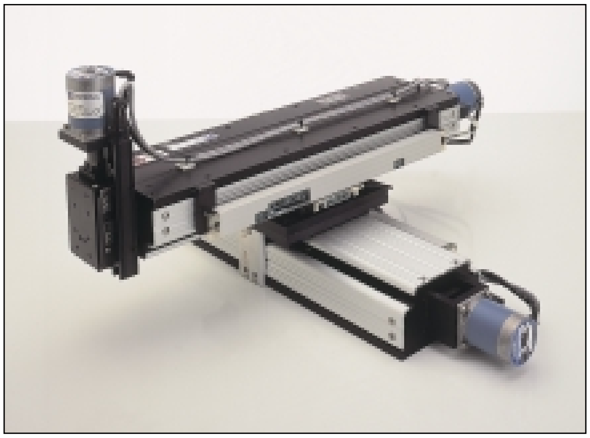
Side Mount Y Axis



X-Y with Independent Z Axis

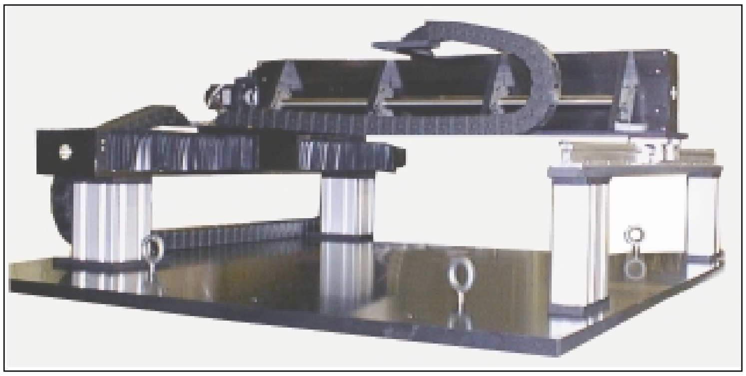
Solutions for Multi-Axis Assemblies and Custom Systems

RB8/RB6 X-Y-Z
assembly for a
vision inspection
system



RC6 (X-Y-C)/CP3 (X-Y-Z) assembly
for a component inspection system

RB8/RB6 X-Y assembly with
an outboard rail for a
dispensing system



RB6 X-Y-Z
assembly for a
coordinate
measuring system

X-Y-Z RC6
assembly for a
positioning system

Technology

Performance Verification and Testing

Testing — A Systematic Approach

Performance verification is necessary to fully understand and document the capabilities of a positioning system. First, performance testing provides positioning results for the entire motion system (controller, drive, motor and precision table). Although it is easier to focus on the performance of specific system components (e.g. ballscrew, controller, linear encoder, etc.), it is dangerous and overly simplistic to extrapolate component specifications to represent the performance of the entire motion system. Ultimately, the performance of the entire system must be proven for the application to work successfully. For example, if a motion system has a 40mm movement commanded, how far does the positioning system actually move? Is the actual movement repeatable (or even acceptable)? Performance verification answers these questions.

Performance testing verifies that a positioning system is operating at the performance specifications required by an application. It also provides a complete overall picture of positioning performance, including performance measurements that may have been accidentally overlooked or omitted when the original application requirements were specified. It is important to note that performance testing also provides the opportunity to see where a positioning system surpasses application performance specifications.

Performance testing also provides the necessary information to maximize positioning system performance. Some motion controllers can compensate for systematic positioning errors provided that these errors are known. Systematic performance testing documents the positioning error profile. This error profile can be programmed back into the motion controller to compensate for this systematic error and improve positioning results.

Application Considerations — Resolution, Accuracy and Repeatability

Before beginning a full discussion covering application considerations and performance testing, it is necessary to clarify a few basic concepts. The first main concept is that resolution, accuracy and repeatability are not identical.

Resolution is one of the most frequently misunderstood terms. Fortunately, it is one of the easiest to clarify. There are 3 types of resolution.

- **Mechanical Resolution** — The mechanical resolution is the ratio of motor shaft revolutions to the movement of the system. Increasing the mechanical resolution (e.g. reducing the lead of the screw) does not make the system more accurate. Please refer to the Drive Screw section for more information.
- **Electrical Resolution** — The electrical resolution of a system is smallest incremental movement that the motion system can detect or resolve to. This is typically the resolution of the encoders. Please refer to the Encoder section for further information.
- **System Resolution** (least incremental motion) — The system resolution is the smallest incremental movement that the motion system can actually achieve. System resolution is determined by the system friction (stiction), the load inertia, the mechanical compliance of the drive train, the torque of the rotary motor, and the controller.

Obviously, system resolution is the most important resolution parameter, and system resolution must be measured. System resolution can be increased by reducing friction (stiction) and reducing load inertia. This is typically accomplished by using air bearings. Certain types of drive mechanisms are also well suited to high resolution applications, such as piezo ceramic motors. Electrical resolution is typically increased by using linear encoders and laser interferometers for feedback. Mechanical resolution can be increased by reducing the drive screw lead or ratio and using a gearmotor.

A quick way to understand the relationship between system resolution and friction (stiction) is to consider the breakaway torque. Systems with lower breakaway torque will have higher resolutions and less wear. IDC's special design and manufacturing techniques are specifically designed to minimize breakaway torque and increase system resolution without introducing backlash.

Accuracy and Repeatability

Understanding the difference between accuracy and repeatability is slightly more complicated. It is beneficial to start by looking at accuracy and repeatability at an intuitive level. Figure 1 shows a system that is both accurate and repeatable. The points are grouped together tightly (repeatability) and their mean location is at the center of the target. In real world applications, most systems would not be able to achieve this type of performance. Figure 2 shows a system that is accurate but not repeatable. The mean location of the points is still at the center of the target; however, the points are not grouped together tightly (not repeatable). In actual practice, this type of performance would be very uncommon. Figure 3 shows a system that is repeatable but not accurate. The points are grouped together tightly, but their mean location is not close to the center of the target. This type of performance is very common in real world applications. Figure 4 shows what is possible with error compensation and direct feedback (from utilizing motion controller error compensation and linear encoders). In this situation, the repeatable system from figure 3 has increased its accuracy with error compensation.

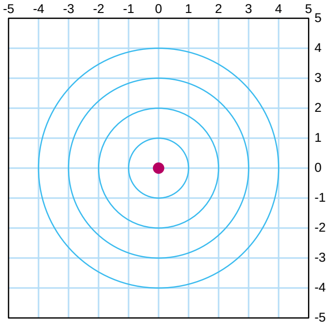


Figure 1: Accurate and Repeatable

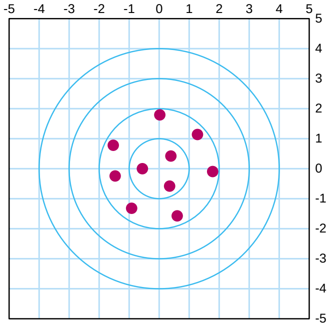


Figure 2: Accurate and Non-Repeatable

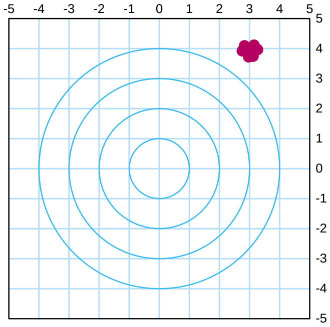


Figure 3: Repeatable and Not Accurate

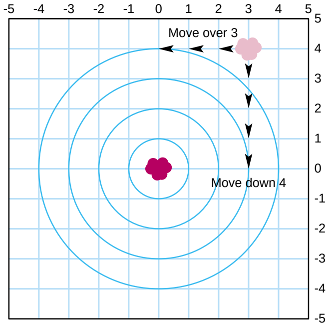


Figure 4: Error Compensation

Intuitively, accuracy and repeatability can be differentiated by their frame of reference. Accuracy provides a measure of how well a positioning system moves relative to an absolute frame of reference. Repeatability provides a measure of how well a positioning system moves relative to its own frame of reference. To better understand this concept, consider the following examples. Applications that require accuracy typically use their positioning systems as an instrument to measure absolute distances relative to the external environment. Applications that require repeatability typically start from a somewhat arbitrary reference point, but then must move correctly relative to that reference point. Accuracy is required when a motion system must move to an exact point in 3-D space. Repeatability is required when a positioning system must move correctly point to point in 3-D space.

The majority of motion applications require repeatability. For example, one typical application that requires repeatability is component placement in electronics assembly. This process usually starts by aligning a feature on the circuit board with a visual reference. Once the board has been aligned, the components are placed relative to the initial alignment. A highly repeatable positioning system can solve this type of application because the system must move correctly relative to itself once the initial reference point has been chosen (by the initial alignment). In contrast, a typical application that requires accuracy might be something like a coordinate measuring machine, which must be able to move to exact points in 3-D space. However, it should be noted that a highly repeatable system may also solve this type of application if the coordinate measuring machine is used to verify specific features on standardized parts. This can be accomplished by having the probe start at one initial feature and then make all the following moves relative to the initial feature.

In summary, here are a few guidelines for differentiating between accuracy and repeatability. Accuracy is harder to achieve than repeatability — it is also more expensive. Most typical positioning applications require repeatability. Accuracy refers to motion compared to the external environment. Repeatability refers to motion compared to the system itself. The accuracy of highly repeatable positioning systems can be improved with error mapping and direct feedback.

Formal Definitions and Standards

After intuitive definitions of accuracy and repeatability have been established, it is also important to look at the formal definitions. Let's start by asking a basic question.

Question:	*What is accuracy?*
Answer:	*Accuracy is the quantitative measure of the degree of conformance to recognized national or international standards of measurement (ASME B5.54-1992).*

This definition establishes 2 basic facts. First, accuracy must be measured. Second, it must be measured according to accepted standards. However, this raises an important question. Which standard should be used? Although there are several widely accepted international testing standards (e.g. JIS B6201 - 1993 (Japan) and NMTBA AMT Publication #1135 - 1972 (USA)), ISO 230-2:1997(E) provides the most meaningful information. All standard IDC Performance Verification Testing for accuracy and repeatability is done according to the directives given in ISO 230-2. All other standard IDC Performance Verification Testing is done according to the directives given in ASME B5.54-1992. Special testing according to other accepted standards is also available. Please contact IDC for details.

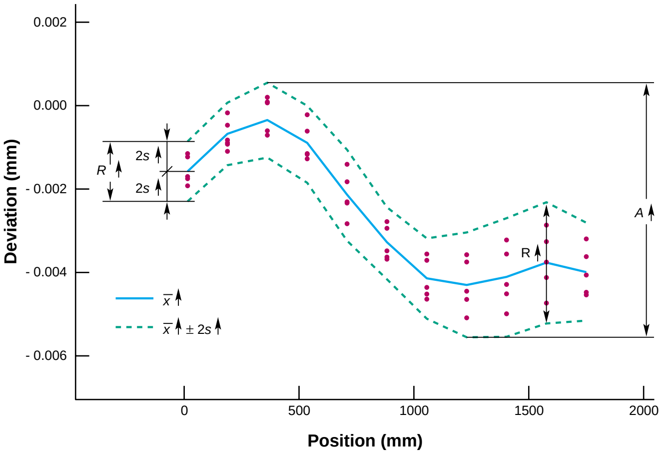
ISO 230-2 Basics

Testing according to ISO 230-2 has the following advantages:

- All tests must be performed in a temperature controlled environment (20°C, 68°F). This provides a standard reference temperature. Changing the environmental temperature causes thermal expansion and contraction, which can cause significant positioning errors (approximately ± 11.7 microns per meter per degree C).
- All tests must include a full warm up cycle that simulates actual operating conditions prior to testing. Some manufacturers purposely omit a warm up cycle to overstate the accuracy of their systems because omitting a warm up cycle prevents the thermal expansion of the drive train caused by frictional heating.
- All tests clearly specify unidirectional (approaching target points from one direction only) and bi-directional (approaching target points from both directions) positioning performance with statistical error bands.
- Linear axes require at least 5 target points per meter. IDC also varies the periodicity of the measuring intervals to avoid masking periodic errors (e.g. a metric drive system has target points spaced in inches).
- Rotary axes require at least 3 target points per 90 degrees.
- Each test requires at least 5 trials per target point per direction of approach. Utilizing multiple trials per target point allows statistical error bands to be calculated. According to the current ISO 230-2 standard, the typical error band is ± 2 times the statistical estimator (standard deviation).

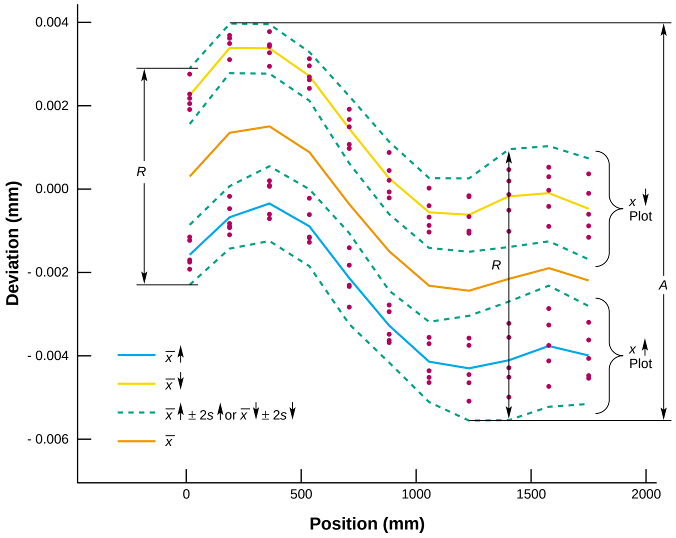
It should be noted that ISO 230-2 is not related to an ISO 9001 or ISO 14001 certification. Typical ISO certifications document consistency in manufacturing procedures; however, they do not address the results of the procedures. In contrast, ISO 230-2 provides a standard testing procedure and standard format for verifying and comparing results. ISO 230-2 is quickly becoming the accepted world standard. For more information please refer to standard ISO 230-2.

Finally, what are accuracy and repeatability? First, let's look at a unidirectional case. As previously stated, unidirectional positioning applications require that the target points are approached from one direction only. The positioning results for unidirectional applications are typically 2-3 times better than bi-directional applications because hysteresis is not included. This figure shows a unidirectional linear positioning plot for a typical single axis system (ordered as TEST 1-1). In this case, 11 target points with 5 trials per target point were used to develop this plot. The center line is the mean unidirectional positional error. This error profile could be mapped back into a motion controller with compensation capabilities to improve positioning results. The top and bottom lines are the statistical error bands. The repeatability at any target point is the distance between the error bands. The unidirectional repeatability of the positioning system (R) is defined as the largest separation between the error bands. The unidirectional accuracy of the positioning system (A) is defined as the largest difference between the top error band and the bottom error band. Intuitively, it is still clear that repeatability measures how well the system moves relative to itself, and accuracy measures how well the system moves relative to the external environment. Another insight into accuracy comes from the origin of ISO 230-2. This standard was originally developed as part of the German DIN standards. In the original text of this standard, (A) is referred to (in German) as uncertainty - meaning that without feedback or error compensation, we know that the system will be able to position within the error band (A) over the entire range of travel relative to the external environment. We also know that the system will be able to position within the error band (R) over the travel range relative to itself.



Unidirectional Accuracy and Repeatability of Positioning

Examining the bi-directional definitions is slightly more complicated. This figure shows a bi-directional linear positioning plot for a typical single axis system (also included in TEST 1-1). The unidirectional plots for both approach directions are shown in as the top and bottom 3 lines. The center line is the mean bi-directional positional error. Again, this information can be used for error compensation in some motion controllers. Similar to the unidirectional example, the bi-directional repeatability of the positioning system (R) is the largest separation between the extreme error bands. The bi-directional accuracy of the positioning system (A) is the largest difference between the top error band and the bottom error band over the tested range. As previously stated, bi-directional positioning errors are typically 2-3 larger than the unidirectional errors due to system hysteresis. Applications with bi-directional requirements are typically high throughput processes.



Bidirectional Accuracy and Repeatability of Positioning

Comparing Other Specifications and Standards

It is very important to understand that IDC defines accuracy and repeatability according to ISO 230-2, which measures the positioning performance of the entire motion system (e.g. controls, drive, motor, coupling, drive screw, encoders, etc.). Other manufacturers often have very subjective definitions that they make up for themselves (based on extrapolating drive screw specifications or inventing test procedures). Although these methods generate impressive specifications for promotional literature, they are not sound engineering practices.

Other manufacturers, specifically those based in Asia, also generate impressive specifications. Some of these specifications relate to loading limits and are discussed in the Bearing Considerations Section. Others relate to positioning. The positioning specifications are related to older JIS test procedures, but several important differences must be noted. First, repeatability is typically measured unidirectionally at 3 target points with 7 trials per target point. Repeatability is then defined as ±1/2 the maximum error, which generates a repeatability specification that is approximately 1/2 of the unidirectional repeatability and 1/4 or less the bi-directional repeatability under the ISO 230-2 test procedures. Accuracy, when measured according to these standards, is also overstated by similar factors.

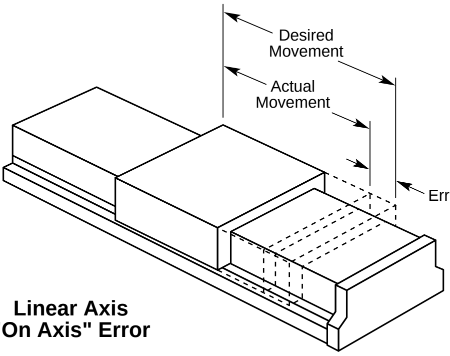
Please remember that comparing positioning specifications can be like comparing apples and oranges. It is important to know what performance specifications are based on before determining which system offers superior performance.

Contouring

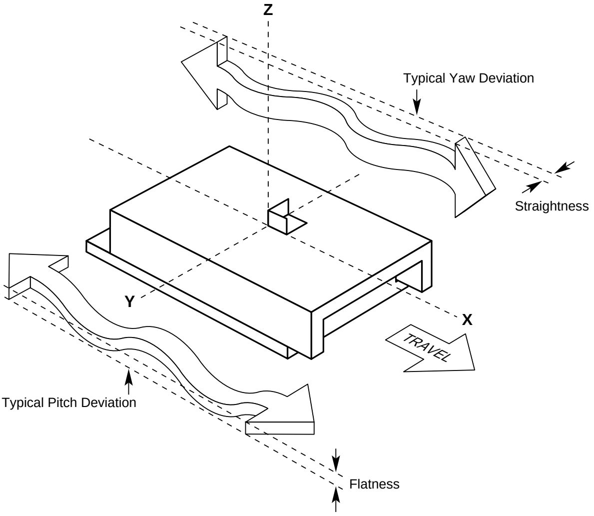
Before continuing, it is important to note that accuracy and repeatability have been defined for point to point movements. Contouring (a.k.a. Path Accuracy) can also be an important application consideration, especially in marking or material removal applications. In these applications, the positioning system must follow a specific path correctly. Contouring applications are inherently more difficult than point to point applications because they do not settle on a specific point. To better understand the difficulties of contouring applications, consider a laser cutting system that must remove material along a specific path. Even if this system utilizes linear encoders, the contouring performance will still be limited because servo systems are based on error correction. A linear encoder may be able to detect a positioning error, but during the time it takes for the controller to detect this error and correct it, the system will be moving and removing material along the wrong path. Unfortunately, a linear encoder cannot un-remove the incorrectly removed material. In practice, the linear encoders can be used to confirm a move profile for this type of system, but they will not remove all the complications from this motion application. For more information on the limitations of linear encoders, please refer to the Linear Encoder Section. In most typical applications, the contouring accuracy will be approximately 2-3 times worse than the point to point accuracy. It is also important to note that contouring applications often involve circular interpolation. Circular interpolation is one of the most demanding applications because it requires sinusoidal accelerations and decelerations from the control system with minimal backlash from the mechanical system. IDC uses preloaded precision ground ballscrews, which are ideal for this type of application. However, the preload of the ballscrews and the overall stiffness of the system will limit the amount of thrust that is possible without introducing significant error into a contouring application. The maximum recommended thrust values are provided for each ballscrew choice in the individual product sections. Please refer to the Multi-Axis Test Procedures for more information.

"On Axis" vs. "Off Axis" Errors

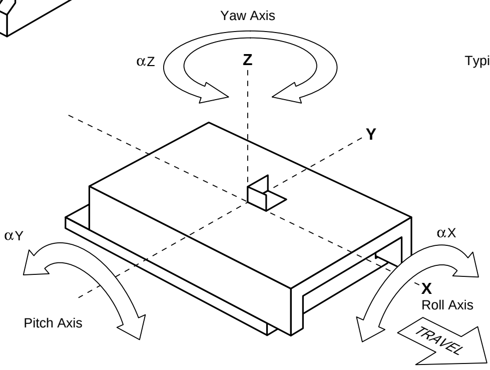
One final distinction must be made. Most of the preceding discussion has been concerned with "On Axis" performance verification. These measures are called "On Axis" because they refer to errors that are largely attributable to the drive train of motion system. In addition to the "On Axis" errors, there can be significant consequences from "Off Axis" errors. "Off Axis" errors are commonly described as angular errors (Roll, Pitch and Yaw) or straightness and flatness (Horizontal Straightness and Vertical Straightness). These errors are largely attributable to the structure and bearings. To understand how these different types of errors can effect a positioning system, consider the following RB6 example. A standard RB6-12 can have up to 14 microns of error in the direction of travel (X) as well as 16 microns of straightness error (Y) and 16 microns of flatness error (Z). This basic uncertainty of this Precision Table would be a 14x16x16 micron cube. However, we have already shown that the actual error in the direction of travel could be mapped and compensated for. The same is true for the "Off Axis" errors (Y and Z); however, it is difficult to compensate for the "Off Axis" errors because they are attributable to the structure and bearings. Still, it important to know these errors. For example, the same RB6 table is allowed certain deviations in roll, pitch and yaw. These angular deviations can be very significant if the top of the payload that the Precision Table is carrying is a large distance beyond the carriage top. This large distance will amplify any angular deviations and cause positioning errors. It must be noted that loading will cause deviations in addition to the "Off Axis" errors already inherent to the Precision Table. For more information on these deviations, please refer to the Structure and Bearings section and the individual product sections.



Linear Axis
"On Axis" Error



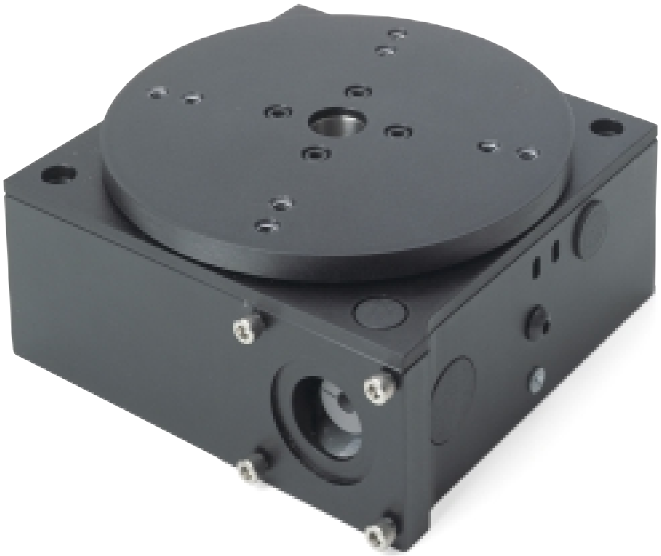
Linear Axis
"Off Axis" Error (Straightness and Flatness)



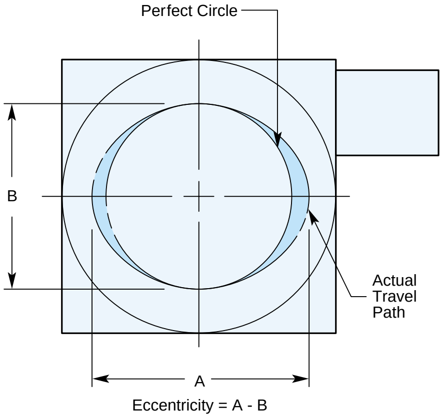
Linear Axis
"Off Axis" Error (Roll, Pitch and Yaw)

Precision Assembly Options

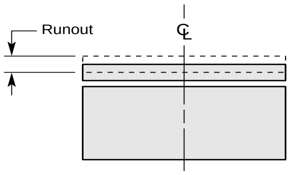
For applications that require lower angular errors and improved straightness and flatness, IDC offers a PRECISION ASSEMBLY option for the PB4, CP8, RB4, RB6, RC6 and RB8. This option is available for standard travel lengths only. The "On Axis" positioning performance is typically not affected. Improved specifications are achieved by additional high precision grinding of the structure. If allowable angular errors are lower than those shown in this catalog, contact IDC or consider using air bearings. The PRECISION ASSEMBLY option is also available for the RG Rotary Table. For the RG, this option improves the runout, eccentricity and wobble off axis errors, but not rotary positioning performance. The PRECISION ASSEMBLY option is typically required for scanning applications.



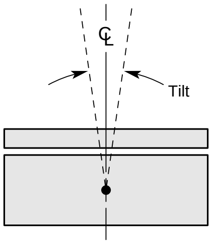
Performance Verification Testing is recommended for all Precision Positioning Table systems. This provides a convenient way to have IDC certify the performance of your positioning system. It is also a sound engineering practice that provides a way to increase performance (error compensation) and eliminates specification misunderstandings.



Rotary Axis Eccentricity Error "Off Axis" Error



Rotary Axis Runout Error "Off Axis Error"



Rotary Axis Tilt Error "Off Axis" Error

Standard Performance Verification Tests

All standard Performance Verification Testing is done in IDC's Metrology Lab with IDC motors, drives and controls (or controls chosen by IDC) unless specified otherwise. Motor tuning is optomized based on unloaded test conditions. Standard testing results are based on the center of the carriage along the measurement line of the top of an unloaded, bolted down Precision Table unless specified otherwise. A two frequency laser interferometer is used for the majority of measurements. An optical level is used to verify certain angular errors, especially roll deviations. A digital autocollimator is also used to verify angular errors (pitch and yaw) as well as rotary positioning accuracy and repeatability (with a polygon mirror). A precision ball bar is used to verify circular interpolation contouring. An inspection grade AA granite is used for all testing. A performance plot is provided for all ordered tests.

Single Axis Tests — Linear

TEST 1-1

Verification of linear accuracy and repeatability as well as pitch and yaw angular errors according to ISO 230-2. This test is recommended for all linear axes.

TEST 1-2

In addition to the tests covered in Test 1-1, horizontal straightness and vertical straightness (nominal straightness and flatness) are also verified according to ISO 230-2.

TEST 1-3

In addition to the tests covered in Test 1-2, the 3-D flatness of the carriage top is also verified according to ISO 230-2. This is a typical test for non-recirculating bearing tables.

TEST 1-4

In addition to the tests covered in Test 1-2, the systematic periodic error is mapped according to ASME B5.54-1992.

TEST 1-5

In addition to the tests covered in Test 1-2, the minimum incremental motion (system resolution) is simulated based on customer supplied application criteria (load, orientation, tuning, etc.).

TEST 1-6

In addition to the tests covered in Test 1-2, acceleration and velocity are measured based on customer supplied application criteria. Settling time and natural frequency are also measured.

TEST 1-7

In addition to the tests covered in Test 1-2, the thermal variation error (TVE) of the positioning system is measured according to ASME B5.54-1992.

Special single axis linear testing is available upon request. Please contact IDC to discuss your requirements.

Multi-Axis Tests — Linear (2 axis system)

TEST 2-1

Each individual axis is tested according to Test 1-1. The linear accuracy and repeatability as well as the pitch and yaw errors of a combined diagonal X-Y movement are verified according to ISO 230-2 and ASME B5.54-1992.

TEST 2-2

In addition to the tests covered in Test 2-1, the horizontal straightness and vertical straightness (nominal straightness and flatness) of a combined diagonal X-Y movement are verified according to ISO 230-2 and ASME B5.54-1992.

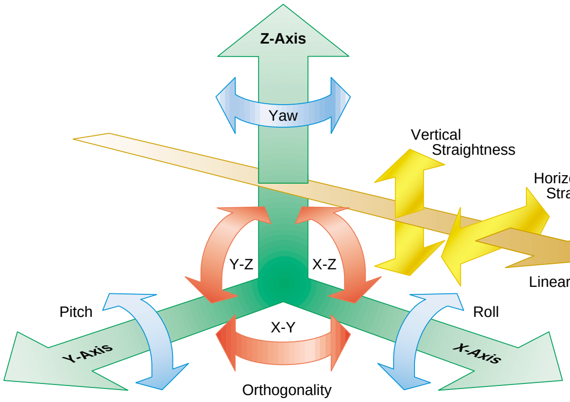
TEST 2-3

In addition to the tests covered in Test 2-2, the orthogonality (squareness) the X-Y assembly is verified according to ASME B5.54-1992.

TEST 2-4*

In addition to the tests covered in Test 2-3, the circular interpolation contouring performance is verified according to ASME B5.54-1992.

Special multi-axis testing is available upon request. Please contact IDC to discuss your requirements.



Motion Terms

*Call to verify availability.

Rotary Axis Testing (ordered for single axis, X-Theta or X-Y-Theta systems).*

Note: These tests apply to the rotary axis only. Don't forget to include linear axis testing for multi-axis systems.

TEST 3-1

Verification of rotary positioning accuracy and repeatability according to ISO 230-2.

TEST 3-2

In addition to Test 3-1, verification of tilt (squareness) according to ASME B5.54-1992 (ASME B89.3.4M-1985), runout and eccentricity.

TEST 3-3

In addition to the tests covered in Test 3-2, the systematic periodic error is mapped according to ASME B5.54-1992 (ASME B89.3.4M-1985).

TEST 3-4

In addition to the tests covered in Test 3-2, the minimum incremental motion (system resolution) is simulated based on customer supplied application criteria.

TEST 3-5

In addition to the tests covered in Test 3-2, acceleration and velocity are measured based on customer supplied application criteria. Settling time and natural frequency are also measured.

TEST 3-6

In addition to the tests covered in Test 3-2, the thermal variation error (TVE) of the positioning system is measured according to ASME B5.54-1992 (ASME B89.3.4M-1985).

Special rotary testing, including an error motion plot according to ASME B89.3.4M-1985, is available upon request. Please contact IDC to discuss your requirements.

*Call to verify availability.

Ordering Examples

Single Axis:

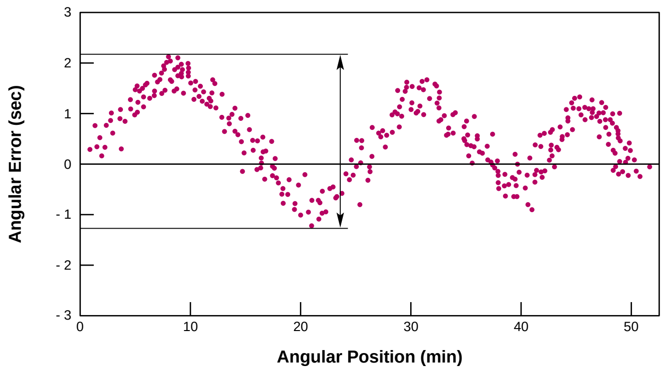
CP8R-12-5G-OE4-P21-LX3-E0	1
TEST 1-2	1

Multi-Axis:

RC6-24-5G-BE4-BN23-LI3-E0-CV1	2
RC6 XYP	1
TEST 2-4	1

Multi-Axis - Rotary X-Y-Theta, Clean Room, SmartStep23 Ideal System with Performance Verification:

RB6-18-5G-OE4-P22T-LI3-E0-CV1	1
RB6-12-5G-OE4-P22T-LI3-E0-CV1	1
CLEAN 100	2
RB6 XYP	1
TEST 2-3	1
RGC-6-180-OE4-P21T-H1	1
CLEAN 100	1
RG/RB6 XYP	1
TEST 3-2	1
SMARTSTEP23	3
IDEAL SYSTEM	3



Rotary Periodic Error

Positioning Terminology

Abbe Error[1]

The measurement error resulting from angular motion of a movable component and an Abbe offset between the scales measuring the motion of that component and the measurement line. Please refer to the Performance Verification and Linear Encoder sections for further details.

Abbe Offset[1]

The instantaneous value of the perpendicular distance between the displacement measuring system of a machine and the measurement line where the displacement in that coordinate is being measured. Please refer to the Performance Verification and Linear Encoder sections for further details.

Acceleration

The positive rate of change in velocity as a function of time. Going from a lower speed to a higher speed. Please refer to the individual product sections for further details on acceleration and deceleration limits.

Accuracy[1]

The quantative measure of the degree of conformance to recognized national or international standards of measurement. Please refer to the Performance Verification section for further details.

Acetal

A resin compound material typically used in leadscrew nuts.

AGMA

American Gear Manufacturers Association

AGMA Class 10

A precision gear classification used by IDC in all RG Rotary Precision Table worm gear drives. Please refer to the Drive Screw Section or the AGMA for further details.

Amplifier

An electronic device for amplifying voltage, current, or power. Also known as a Drive. Please refer to the IDeal System section for further details on integrating IDC Drives and Controls into your positioning system.

Angular Contact Bearings

Preloaded rotary bearings used to support drive screws in Linear Precision Tables and the tabletop in Rotary Precision Tables. Please refer to the Bearing and Drive Screw sections for further details.

Angular Errors

The angular motion of a carriage designed for linear motion. Please refer to the Performance Verification section. See also Roll, Pitch and Yaw.

Anodize

A protective coating created on the aluminum structure, typically black or clear. Please refer to the Structure section and the individual product sections for further details.

Arc-Second

An angular unit of measurement. 1/3600 of 1 degree.

ASME

American Society of Mechanical Engineers.

ASME B5.54-1992

The ASME standard for the performance evaluation of computer numerically controlled machining centers. Please refer to the Performance Evaluation section or the ASME for further details.

ASME B89.3.4M-1985

The ASME standard for axes of rotation. Please refer to the Performance Evaluation section or the ASME for further details.

Axial Load

The load typically generated by the move profile in horizontal applications or by the move profile and gravity in vertical applications, in the direction of travel. Please refer to the individual product sections for further details on loading.

Axis of Rotation[1]

A line about which rotation occurs.

Autocollimator[1]

An optical instrument, which allows measurement of the angle between its optical axis and a mirror, which is imaged through the instrument. Please refer to the Performance Verification section for further details.

B10 Life

See Dynamic Capacity.

Backlash

The amount of free play or clearance between the components of the drive train. The "dead band" that occurs when the direction of motion is reversed. Please refer to the Performance Verification section for further details. See also Hysteresis.

Ball Bar (telescoping)[1]

A gauge consisting of 2 highly spherical tooling balls of the same diameter connected by a rod, which is held by a socket at both ends and contains an accurate displacement transducer which allows the accurate measurement of the change of length of the ball bar as one socket moves with respect to the other. Ball bars are used to verify circular interpolation performance. Please refer to the Performance Verification section for further details.

Ball Rod Bearing

A non-recirculating bearing system that utilizes ball bearings and steel rods. Although the load limits are relatively low for this type of bearing due to the possible accidental deformation of the rods, this bearing design is very smooth and has very low friction. Please refer to the Bearing section for further details.

Ballscrew

A device that converts rotary motion into linear motion by utilizing rolling ball bearing contact. Please refer to the Drive Screw section for further details.

Technology

Bandwidth

The range within a band of frequencies over which a device can operate. Bandwidth limitations associated with encoders and controllers may require a tradeoff between top speed and resolution. Please refer to the Linear Encoder section for further details.

Base

The bottom structural component of a Positioning Table that is typically stationary.

Base Plate

A rigid structural member used to build large multi-axis systems.

Beam Coupling

A reasonably stiff one piece coupling typically used in low cost applications. Please refer to the Coupling section for further details.

Bearing

A design component that supports a specific load while allowing motion in one degree of freedom with sliding or rolling contact. Please refer to the Bearing section for further details.

Bellows Coupling

A very stiff one piece coupling with collars that is typically used with shaft attachment servos. Please refer to the Coupling section for further details.

Bellows Cover

A flexible neoprene coated polyurethane protective cover utilized by several IDC Precision Tables to reduce environmental contamination. Please refer to the Environmental section and the individual product sections for further details.

Bi-directional

Motion that approaches specified target points from both directions. Please refer to the Performance Verification section for further details. See also Unidirectional.

Breakaway Torque

The torque necessary to start a Precision Table axis' motion. Please refer to the individual product sections for breakaway torque ratings. See also Running Torque.

Brinelling

A permanent deformation in a bearing way, which occurs at and beyond the Static load limit.

Cantilevered Load

Any asymmetric load that generates moment loads on the structure and bearings of a Positioning System. These moment loads can be static or dynamic. Please refer to the individual product sections for further loading details.

Cantilevered Top

A Precision Table where the carriage extends beyond the base. This is typical for non-recirculating bearing designs. Please refer to the Bearing section and the individual product sections for further details.

Carriage

The top of a Linear or Rotary Precision Table, which is typically in motion.

Clean Room[2]

A room in which the concentration of airborne particles is controlled and which contains one or more clean zones. Please refer to the Environmental section for further details.

Clean Zone[2]

A defined space in which the concentration of airborne particles is controlled to meet a specified airborne particulate cleanliness class. Please refer to the Environmental section for further details.

Coefficient of Friction

The ratio of the force (thrust) required to move a load to the weight of the load being moved. Please refer to the individual product sections for individual coefficients of friction.

Cogging

The relative lack of smoothness associated with the motion of a rotary motor. Please refer to the Motor section for further details.

Column Loading

The maximum axial load allowable before the drive screw buckles. Please refer to the Drive Screw section for further details.

Compliance

The amount of linear or angular deflection that occurs when a structure is subjected to a given load or moment. Please refer to the individual product sections for compliance ratings. The inverse of Stiffness. See also Stiffness.

Concentricity

See Eccentricity.

Contouring

The coordination of two or more axes (e.g. linear or circular interpolation) to generate a desired path correctly. Please refer to the Performance Verification section for further details.

Cosine Error[1]

The measurement error in the motion direction caused by angular misalignment between a linear displacement measuring system and the gauge or displacement being measured. Please refer to the Linear Encoder and Performance Verification sections for further details.

Critical Speed

The maximum rotational shaft speed of a drive screw in a linear Precision Table (limited by screw diameter, length between the screw supports and method of screw support). Please refer to the Drive Screw section for further details.

Cross Roller Bearing

A low friction bearing system, typically non-recirculating, that utilizes cylindrical roller bearing elements staggered by 90 degrees. The chief advantage of this design is the increased bearing surface contact that typically results in higher load capacities and longer life. Please refer to the Bearing section for further details.

Dead Band

Motion is commanded, but the system does not respond. Commonly associated with backlash and hysteresis. See also Backlash and Hysteresis.

Deceleration

The negative change in rate of velocity as a function of time. Going from a higher speed to a lower speed. Negative acceleration. Please refer to the individual product sections for further details on acceleration and deceleration limits.

Deflection

A physical change or deformation in a structure caused by a load (direct force or moment). Please refer to the individual product sections for further details on loading and deflection. See also Stiffness and Compliance.

Degrees of Freedom

Any of a limited number of ways in which a body may move or in which a dynamic system may change. There are 6 possible degrees of freedom (3 forces — X, Y, and Z and 3 moments — Roll, Pitch and Yaw). A typical motion axis has 5 static (non-moving) and 1 dynamic (moving) degrees of freedom. Please refer to the Application Data Form for further details.

DIN

German Industrial Standards (Deutsche Industrie Normen). These standards are typically the basis for ISO standards. All standard IDC ballscrews are certified according to DIN 69051. Please refer to the Drive Screw Section or DIN for further details.

Dm-N Value

The maximum linear speed of the balls within the ballscrew nut. The pitch circle diameter times the revolutions per minute. Please refer to the Drive Screw section for further details.

Drive

See Amplifier.

Drive Ratio

The ratio of the input revolutions to the output revolutions. Please refer to the RG Rotary Table and Motor sections for further details.

Drive Screw

A mechanical device used for positioning or power transmission as the main drive train of the motion system. Please refer to the Drive Screw section for further details. See also Ballscrew, Leadscrew and Worm Gear.

Dual Loop Control

A servo control system that utilizes 2 encoders. Typically, a linear encoder is used to close the position loop and a rotary encoder is used for the other feedback loops and motor commutation. This control system is typically utilized in demanding applications. Please refer to the Linear Encoder section for further details.

Duty Cycle

The ratio of system motion time to the total time for a worst case motion cycle during a 10 minute period. Please refer to the Drive Screw and Motor sections for further details.

Dynamic Capacity

The load under which 90% of the contact elements in the bearing will retain geometric integrity after traveling a fixed distance (typically 50km). The dynamic capacity is used for life calculation purposes only. The bearing life calculated with the dynamic capacity is also known as the B10 Life. Please refer to the Bearing section for further details.

Dynamics

The Newtonian physics (forces and moments) associated with bodies in motion. Please refer to the individual product sections for further details on loading limits.

Eccentricity

The maximum deviation between a perfect circle and the actual path traveled by a point at a 6 inch radius on a Rotary Positioning Table over a full 360 degree rotation. Please refer to the Performance Verification section for further details.

Efficiency

The ratio of transmitted power or torque to the input power or torque.

Electrical Noise

Electrical signals, typically generated by a drive, which can cause other electrical devices to malfunction, especially if they are not properly shielded or grounded. Please refer to the Linear Encoder for further details.

Electrical Resolution

The smallest incremental movement that a motion system can detect or resolve to. This is typically the resolution of the encoders. Please refer to the Linear Encoder Performance Verification sections for further details.

Encoder

An electrical pulse generating device that is used to determine the position of a mechanical system (and possibly commutate an electric motor). IDC Precision Tables can utilize rotary and linear encoders. Please refer to the Motor and Linear Encoder sections for further details.

End of Travel Switch

See Limit Switch.

Error[1]

The difference between the actual response of a machine to a command issued according to the accepted protocol of that machine's operation and the response to that command anticipated by that protocol. Please refer to the Performance Verification section for further details.

Error Band

The maximum allowable difference between the most positive and most negative errors. Please refer to the Performance Verification Section for further details.

Error Compensation

A motion controller utilizing performance verification testing and direct feedback to improve positioning results. Please refer to the Performance Verification section for further details.

Error Motion[1]

The change in position relative to the reference coordinate axis, of the surface of a perfect work piece with its centerline coincident with the axis of rotation. See Error Motion Plot.

Error Motion Plot

An extensive error motion polar plot of a rotary axis or spindle in accordance with ASME B5.54-992 and ASME B89.3.4M-1985. Please refer to the Performance Verification section for further details.

FED-STD-209E

The US Federal Standard for Airborne Particulate Cleanliness Classes in Clean Rooms and Clean Zones (1992). Please refer to the Environmental section for further details.

Feedback

The return to the input of a part of the output of a machine, system, or process (as for producing changes in an electronic circuit that improve performance or in an automatic control device that provide self-corrective action). Please refer to the Linear Encoder section for further details.

Fixed-Free

A rigid method for supporting the drive screw of a Linear Positioning Table where one end of the screw is rigidly supported and one end is unsupported. Due to critical speed issues, this configuration can only be used on relatively small, short travel Positioning Tables. Please refer to the Drive Screw section for further details.

Fixed-Simple

A very rigid method for supporting the drive screw of a Linear Positioning Table where both ends of the screw are supported (one rigidly). This configuration is necessary for Positioning Tables with long travels or critical speed issues. Please refer to the Drive Screw section for further details.

Flatness

See Vertical Straightness.

Footprint

The relative physical size, typically the cross sectional area, of positioning system. Please refer to the individual product sections for further details.

Friction

The force that resists relative motion between bodies in contact. See also Coefficient of Friction.

Gearmotor

The combination of a motor and a gear reduction. Please refer to the Motor section for further details.

Granite

Igneous rock formation with visibly crystalline texture formed essentially of quartz and orthoclase. Granite is lapped and polished to very fine tolerances for use in the assembly and inspection of precision positioning systems. IDC uses AA inspection grade granite for all metrology. Please refer to the Performance Verification section for further details.

Grating Period

The actual distance between graduations on an encoder. Please refer to the Linear Encoder for further details.

Hall Effect Sensor

A highly repeatable non-contact sensor that detects the proximity of a magnet. All standard IDC limit switches use Hall effect sensors. Please refer to the Limit Switch section for further details.

Hard Stop

The physical end of travel. Limit switches are typically used to prevent collisions with the hard stops of a Positioning Table. Please refer to the Limit Switch section for further details.

Helicoil

Steel locking inserts in the carriage that prevent mounting screws from becoming loose. Please refer to the Structure section and the individual product sections for further details.

HMI

Human Machine Interface. A device that enables an operator to communicate with a motion system.

Home Switch

See Limit Switch.

Horizontal Straightness

Also known as Nominal Straightness. The positional deviation of the carriage top from the horizontal plane for a linear axis over the travel length. Please refer to the Performance Verification section for further details.

Hysteresis[1]

A component of bi-directional repeatability caused by mechanisms such as drive train clearance, guideway clearance, mechanical deformations, friction and loose joints. Two types of Hysteresis are defined

Setup Hysteresis[1]

The Hysteresis of the various elements in a test setup, normally due to loose mechanical connections.

Machine Hysteresis[1]

The Hysteresis of the machine structure when subjected to specific loads. Please refer to the Performance Verification section for further details. See also Backlash.

IDeal System

A complete, fully integrated positioning system that includes a Precision Table and an IDC drive or control. Please refer to the IDeal System section for further details.

Impact Load

Loading attributable to striking, especially of one body against another. Loading due to forceful contact or a collision. Certain Precision Tables are not suitable for handling impact loads. Please refer to the Bearing section for further details.

Inertia

A property of matter by which it remains at rest or in uniform motion in the same straight line unless acted upon by some external force. See also Rotational Inertia.

Input Torque

The maximum allowable torque that the motor can supply to a Positioning Table without the potential of causing damage to the Positioning Table itself. Please refer to the individual product sections for further details on input torque limits.

Inverted Load Rating

The normal load rating that is allowed when the typical direction of the load is reversed and the carriage is in tension instead of compression. Please refer to the individual product sections for further details on loading limits.

IP Rating

The initials IP stand for International Protection in International Protection Code (from IEC 529). A system of ratings to classify the environmental protection of industrial systems and components. Please refer to the Environmental section for further details.

ISO

International Standards Organization. The main source for industrial standards in Europe, typically known for ISO 9001 and ISO 14001 process certification standards. Please contact ISO for further details on their various standards.

ISO 230-2

The international test code for the determination of accuracy and repeatability of positioning numerically controlled axes (ISO 230-2:1997(E)). This is IDC's standard for accuracy and repeatability. Please refer to the Performance Verification section for further details.

JIS

Japanese Industrial Standards. The main source for industrial standards in Asia. Due to fundamental differences in how terminology is specified, positioning system accuracy and repeatability measurements obtained according to JIS standards will vary greatly from those measured according to ISO or NMTBA standards. Please refer to the Performance Verification section for further details.

JIS C3

A ballscrew accuracy class (from JIS 1192) that allows a maximum lead error of 8 microns per 300mm and 6 microns per revolution. Please refer to the Drive Screw section for further details.

Laser Interferometer[1]

A fringe counting interferometer for displacement measurement which uses a laser as a light source. An instrument which employs two beams of monochromatic light whose interference provides the basis of measurement. Please refer to the Performance Verification section for further details.

Lead

The linear distance traveled during a complete screw rotation. Often confused with pitch. Please refer to the Drive Screw section for further details.

Leadscrew

A device that converts rotary motion into linear motion by utilizing thread to thread contact. Please refer to the Drive Screw section for further details.

Level

A device for establishing a horizontal line or plane by means of a bubble in a liquid that shows adjustment to the horizontal by movement to the center of a slightly bowed glass tube. Please refer to the Performance Verification section for further details.

Limit Switch

A sensor (IDC uses Hall effect switches as standard) that is used to signal the ends of travel and an arbitrary reference position (home). Please refer to the Limit Switch section for further details.

Lithium Soap Base Grease

A typical lubricant used for Positioning Table components. Please refer to the Bearing and Drive Screw sections for further details.

Load

The forces to which a structure is subjected due to weight or movement. The forces to which a given object is subjected. Please refer to the individual product sections for loading limits.

Lost Motion

See Backlash.

Lubrication

Applying a substance, such as grease, that is capable of reducing friction, heat, and wear when introduced as a film between solid surfaces. Please refer to the Bearings and Drive Screw sections for further details.

Measurement Line[1]

A line in the work zone of a machine along which measurements are taken. Please refer to the Performance Verification section for further details.

Mechanical Resolution

The ratio of motor shaft revolutions to the movement of the positioning system. Please refer to the Performance Verification section for further details.

Metrology

The science of weights and measures or of measurement. Please refer to the Performance Verification section for further details.

MIL-STD 8DE

A widely accepted environmental specification program developed by the US Military.

Moment

A cantilevered load with respect to the structure and bearings that gives rise to a torque. Please refer to the Bearing section and the individual product sections for further details.

Moment of Inertia

A measure of the resistance of a body to angular acceleration about a given axis that is equal to the sum of the products of each element of mass in the body and the square of the element's distance from the axis. Please refer to the individual product sections for further details.

Momentum

Mass times velocity. Please refer to the Limit Switch section for further details.

Motion Controller

The "brain" of the motion system. A device that generates the necessary motion signals and controls them. Please refer to the IDeal System section for further details on integrating IDC Drives and Controls into your positioning system.

Motion System

A regularly interacting or interdependent group of components forming a unified machine that produces motion. This includes the HMI, the motion controller, the drives, motors, mechanical devices and encoders. Please refer to the Performance Verification and IDeal System sections for further details.

Motor

A rotating machine that transforms electrical energy into mechanical energy. Please refer to the Motor section for further details.

Natural Frequency

The frequency at which a structure or component inherently resonates at. Please refer to the Drive Screw and Coupling sections for further details.

NEMA

National Electrical Manufacturers Association. The main source of standardized electric motor dimensions in North America. Please refer to the Motor section for further details.

Neoprene

Synthetic-elastic polymer with excellent resistance to moisture. IDC uses neoprene polyurethane coated bellows. Please refer to the Environmental section for further details.

NMTBA

National Machine Tool Builder's Association. One of the first internationally recognized standards for accuracy and repeatability that utilized statistical error bands. Accepted primarily in North America. Please refer to the Performance Verification section for further details.

Nominal Diameter (screw)

The reference diameter of a drive screw typically used for inertia calculations. Please refer to the individual product sections for further details.

Non-recirculating Bearings

Bearings that utilize non-recirculating contact elements (e.g. cross roller bearings). Please refer to the Bearing section for further details.

Normal Load

The load supported by the structure and bearings that is perpendicular to the direction of travel and directed into the top of the carriage. Please refer to the Bearing section and the individual product sections for further details.

Normally Closed

A position sensor whose output voltage transitions from HIGH to LOW when activated. Please refer to the Limit Switch section for further details.

Normally Open

A position sensor whose output voltage transitions from LOW to HIGH when activated. Please refer to the Limit Switch section for further details.

Off Axis Error

The positional errors that are largely attributable to the structure and bearings that are not in the direction of travel. Please refer to the Performance Verification section for further details.

Oldham Coupling

A stiff 3 piece coupling typically used with steppers. Please refer to the Coupling section for further details.

On Axis Error

The positional errors largely attributable to the drive train that are in the direction of travel. Please refer to the Performance Verification section for further details.

Orthogonality

The degree of perpendicularity between 2 axes. Please refer to the Multi-Axis section for further details.

Outgassing

The removal of occluded gases from materials usually by heating or vacuum. Please refer to the Environmental section for further details.

Overshoot

The amount of over correction in an underdamped control system. Please refer to the Coupling and Performance Verification sections for further details.

Path Accuracy

See Contouring.

Periodic Error[1]

An error in the linear displacement accuracy of a machine that is periodic over an interval, which naturally coincides with the natural periodicity of the machine. Please refer to the Performance Verification section for further details.

Pitch[1]

The angular motion of a carriage, designed for linear motion, about an axis perpendicular the motion direction and the yaw axis. Please refer to the Performance Verification section for further details.

Pitch (drive screw)

The distance between the threads on a drive screw. This is the inverse of lead for single start drive screws. Because some drive screws have more than one start, lead is the preferred term for describing drive screw resolution. Please refer to the Drive Screw and Performance Verification sections for further details.

Pitch Circle Diameter

The path followed by the centerline of the balls in a ballscrew.

Plate Covers

Protective covers used on the RC6 Precision Tables. Please refer to the RC6 section for further details.

Precision

See Repeatability.

Preload

The deliberate introduction of mechanical interference to reduce hysteresis. Please refer to the Drive Screw and Performance Verification sections for further details.

Recirculating Bearings

Bearings that utilize recirculating contact elements (e.g. linear guideways). Please refer to the Bearing section for further details.

Repeatability[1]

The ability of a machine to sequentially position a tool with respect to a work piece used in similar conditions. Please refer to the Performance Verification section for further details.

Resolution

There are 3 types of resolution — mechanical, electrical and system. Please refer to the individual definitions or the Performance Verification section for further details.

Resonance

A harmonic response of large amplitude in a mechanical or electrical system caused by a relatively small periodic stimulus of the same or nearly the same period as the natural frequency of the system. Please refer to the Performance Verification section for further details.

Retainer

Part of the bearing structure that holds the contact elements (balls or cross rollers) in place. Please refer to the Bearing Section for further details.

Retainer Creep

The slow elongation or displacement of a non-recirculating bearing retainer due to prolonged exposure to high temperature or stress. Please refer to the Bearings section for further details.

Rigid

Stiff. Resistant to deflection. See also Stiffness and Compliance.

Ripple

See Cogging.

Roll[1]

The angular motion of a carriage, designed for linear motion, about the longitudinal axis of travel. Please refer to the Performance Verification section for further details.

Root Diameter

The smallest diameter of the threaded portion of a drive screw. Please refer to the Drive Screw section for further details.

Rotational Error Relative to Motion

See Angular Errors.

Rotational Inertia

See Moment of Inertia.

Running Parallelism

The parallelism tolerance, over the travel length, between separate surfaces in a bearing assembly. This measurement is often used instead of straightness and flatness by bearing manufacturers who also manufacture Positioning Tables. Please refer to the Bearing and Performance Verification sections for further details.

Running Torque

The torque required to sustain the motion of a Positioning Table carriage. Please refer to the individual product sections for further details. See also Breakaway Torque.

Runout[1]

The total displacement measured by a fixed instrument sensing against a moving surface or moved with respect to a fixed surface. Please refer to the Performance Verification section for further details.

Servo

Abbreviation for servo motor or servo motor driven positioning system. Please refer to the Motor section or the individual product sections for further details.

Settling Time[1]

The time required between the contact of a proportional probe with a measurement point and the time at which valid data may be taken. Please refer to the Coupling and Performance Verification sections for further details.

Side Load

The load supported by the structure and bearings directed along the lateral or transverse axis. Please refer to the Bearing section and the individual product sections for further details.

Slide

A Positioning Table without a drive train. Please refer to the Drive Screw section for further details.

Spacer Plate

A metal plate, typically aluminum, which is used to connect dissimilar IDC axes in an X-Y assembly. A spacer plate is also necessary for connecting CP3's in an X-Y assembly. Please refer to the Multi-Axis section for further details.

Speed

The change in position as a function of time without regard to direction. Please refer to the individual product specifications for velocity limitations.

Squareness

See Orthogonality.

Stack Up Errors

The angular errors attributable to the bottom, supporting axis that are transmitted to the top, supported axis in a multi-axis assembly. Please refer to the Linear Encoder and Multi-Axis sections for further details.

Standard Deviation

A measure of the dispersion of a frequency distribution that is the square root of the arithmetic mean of the squares of the deviation of each of the class frequencies from the arithmetic mean of the frequency distribution. Please see Statistical Estimator.

Start (screw)

The number of separate ball tracks (ballscrew) or threads (leadscrew) on a screw, typical in high lead applications. Please refer to the Drive Screw section for further details.

Static Capacity

The amount of load that a bearing can sustain before permanently deforming the bearing way by 0.0001 times the diameter of the contact element. Please refer to the Bearing section for further details.

Statics

The Newtonian physics (forces and moments) associated with bodies (or degrees of freedom) at rest and in motion. Please refer to the individual product sections for further information on loading limits.

Statistical Estimator

The standard deviation, used in ISO 230-2, to establish the correct statistical error bands. Please refer to the Performance Verification section for further details.

Stepper

Abbreviation for step motor or step motor driven positioning system. Please refer to the Motor section or the individual product sections for further details.

Stiction

The static friction that must be overcome to impart motion to a body at rest. See also Breakaway Torque and Resolution. Please refer to the Performance Verification section for further details.

Stiffness

The amount of force required to cause a linear deflection of a certain size, or the amount of torque required to cause an angular deflection of a certain size. The inverse of compliance. Please refer to the individual product sections for stiffness ratings. See also Compliance.

Straightness

See Horizontal Straightness and Vertical Straightness.

System Resolution

The smallest incremental movement a motion system can actually achieve. Please refer to the Performance Verification section for further details.

Target Points

The commanded points during a positioning performance test. Please refer to the Performance Verification section for further details.

Thermal Drift[1]

A long-term performance test to determine the Temperature Variation Error (TVE) for a positioning system. Please refer to the Performance Verification section for further details.

Thermal Expansion

The material dependent dimensional changes due to a change in temperature. Please refer to the Performance Verification section for further details.

Thermal Variation Error (TVE)[1]

An estimate of the maximum possible measurement error induced solely by deviation of the environment from reference thermal conditions. See also Thermal Drift.

Thrust Load

See Axial Load.

Tilt[1]

Rotary axis error motion component referring to the error motion in an angular direction relative to the Z reference axis. Also known as wobble, conning and rotary axis squareness. Please refer to the Performance Verification section for further details.

Torque

A force applied at an offset which gets to produce rotation or force times distance.

Torsion

The state of being subjected to an applied torque.

Transient Force or Moment

A temporary external force or moment applied to the positioning system.

Travel

The longest possible displacement a motion element can achieve. IDC defines travel as the distance between the end of travel limit switches. Although there is some additional travel available (space for deceleration and bellows), utilizing all the available travel between the hard stops is not recommended. Please refer to the individual product sections for further details.

Twist

See Windup.

Uncertainty

The maximum potential 3-D positional deviation for a specific axis or system. Please refer to the Performance Verification section for further details.

Unidirectional

Motion that approaches specified target points from one direction only. Please refer to the Performance Verification section for further details. See also Bi-directional.

Vacuum

The absence of matter, specifically gaseous material. Vacuums are typically specified in 10^{-x} torr. Please refer to the Environmental section for further details.

Velocity

The change in position as a function of time. Velocity is also direction dependent - speed is not. Please refer to the individual product specifications for velocity limitations.

Velocity Ripple

The percentage of the total maximum fluctuation above and below (maximum minus minimum) the commanded velocity.

Vertical Straightness

Also known as nominal flatness. The positional deviation of the carriage top from the vertical plane for a linear axis over the travel length. Please refer to the Performance Verification section for further details.

Warm Up Cycle

Motion cycles, prior to testing or operation, which simulate operating conditions. Utilizing a warm up cycle can prevent overstating positioning system accuracy. Please refer to the Performance Verification section for further details.

Windup

The angular deflection caused by applying a torsional load to a cylindrical body, typically a coupling or long, slender drive screw, which causes the driven end of the body to rotate beyond the opposite end. Please refer to the Coupling section for further details.

Wiper

Seals, typically on recirculating bearing blocks, which protect the blocks from environmental contamination. Please refer to the Structure and Bearings section for further details.

Wobble

See Tilt.

Worm Gear

A set of gears in which one member of the pair has teeth wrapped around a cylindrical body like screw threads. All IDC RG Rotary Precision Tables use worm gear drives. Please refer to the Drive Screw section for further details.

Yaw[1]

The angular motion of a carriage, designed for linear motion, about a specified axis perpendicular to the direction of travel. For horizontal axes, the specified axis is vertical. Please refer to the Performance Verification section for further details.

Z Bracket

A rigid structural element that is used to connect axes orthogonally when one of the axes is vertical. Please refer to the Multi-Axis section for further details.

[1] ASME B5.54-1992

[2] FED-STD-209E (US Federal Standard)

Specifications

Typical Applications

- Pick and Place
- Inspection
- Sensor Positioning
- Light Duty Assembly
- Vertical Applications
- Gauging
- Alignment
- NOT Designed for Heavy Impact or Heavy Moment Loading

General Specifications

Materials	Top and base — black anodized aluminum alloy (6061 and cast tool plate); Screw and cross roller bearings — 303 stainless steel; Leadscrew nut — acetal
Cross Section	66.8mm x 44.5mm (2.63 inches x 1.75 inches)
Travel Lengths (including limit switches)	25.4mm (1 inch), 50.8mm (2 inches), 76.2mm (3 inches), 101.6mm (4 inches), 127.0mm (5 inches), and 152.4mm (6 inches) (please refer to Travel Dependent Specifications)
Drive Screws	Preloaded precision rolled leadscrew (zero backlash) Nominal diameter 9.525mm (0.375 inches)
Leadscrew Lead Options	0.635mm (0.025 inches), 2.54mm (0.1 inches), or 5.08mm (0.2 inches) (please refer to Travel Dependent Specifications for maximum speeds)
Bearings	Precision non-recirculating cross roller bearings Nominal coefficient of friction 0.003
Couplings	Bellows, Oldham or Stainless Steel Beam (please refer to Coupling Section)
Motors	Stepper (standard, T or V options) or Servo Nominal NEMA 17 or NEMA 23 frame size (please refer to Stepper Section G-1, Servo Section H-1 and Motor Section)
Limit Switches	External Hall Effect switches — adjustable 3 position or 2 position — normally closed (please refer to Limit Switch Section)
Linear Encoder Resolution	1 micron (0.000039 inches) or 2 microns (0.000079 inches) (please refer to Linear Encoder Section)
Environment	General industrial, clean room or vacuum (please refer to Environmental Section)
Normal Ambient Temperature	20°C ± 15°C (68°F ± 27°F) — special high or low temperature preparation also available 760 torr — 10^{-3} torr (standard preparation) — up to 10^{-7} torr (special preparation)
Normal Cleanliness	Class 1000 (standard preparation) — up to Class 100 (special preparation)
Audible Noise (max.)	60 dB at top speed (1m away from positioning system)
Maximum Input Torque	50 oz-in

Specifications

Global Specifications

Leadscrew Accuracy Tolerance1,2 (maximum lead error tolerance)	90 microns per 300mm — 7.5 microns per 25mm 0.0036 inches per foot — 0.0003 inches per inch
Undirectional Repeatability (max.)[1,2] (without linear encoder)	20 microns (0.00080 inches)
Bi-directional Repeatability (max.)[1,2] (without linear encoder)	30 microns (0.00120 inches)
Limit Switch Repeatability[2]	50 microns (0.002 inches) (please refer to Limit Switch Section)
Breakaway Torque (max.)[2]	0.106 Nm (15 oz-in)
Running Torque (max.)[2]	0.085 Nm (12 oz-in)
Nominal Acceleration (max.)[2]	1.0 g — leadscrew
Duty Cycle	60% — leadscrew
Nominal Straightness[2,3] (horizontal (straightness)	12 microns per 25mm (0.00048 inches per inch) Not to exceed travel dependent specifications
Nominal Flatness[2,3] (vertical (straightness)	10 microns per 25mm (0.00040 inches per inch) Not to exceed travel dependent specifications
Normal Load Stiffness[2,3]	1 kg(f) per micron (56,000 lbs. per inch)
Side Load Stiffness[2,3]	0.18 kg(f) per micron (10,000 lbs. per inch)
Axial Load Stiffness[2,3]	0.04 kg(f) per micron (2,300 lbs. per inch)
Roll Moment Compliance[2,3]	83 arc-sec per Nm (110 arc-sec per ft-lb.)
Pitch Moment Compliance[2,3]	48 arc-sec per Nm (65 arc-sec per ft-lb.)
Yaw Moment Compliance[2,3]	122 arc-sec per Nm (165 arc-sec per ft-lb.)
Precision X-Y Mounting Orthogonality (XYP)[2,3]	20 arc-sec

1 For applications requiring higher specification, interferometer testing or a linear encoder may be necessary. Please refer to the Performance Verification Section and the Linear Encoder Section.

2 Please consult IDC if your application requirements exceed catalog specifications.

3 Based on the centerline of the table top.

All specifications are based on ISO 230-2 measurements of an unloaded, bolted down Precision Table with optimized motor tuning. These specifications were generated by measuring the peformance of a complete motion system that utilized IDC motors, drives and controls.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications

Travel Dependent Specifications

Standard Travels

(Travel includes space for limit switches)

	CP3-1	CP3-2	CP3-3	CP3-4	CP3-5	CP3-6
Travel — mm (inches)	25.4 (1)	50.8 (2)	76.2 (3)	101.6 (4)	127.0 (5)	152.4 (6)
Accuracy (error max.) — microns (inches)	75 (0.003)	75 (0.003)	75 (0.003)	75 (0.003)	75 (0.003)	75 (0.003)
Inertia — kgm^{2}x10^{-6} (oz-in-s^{2}x10^{-3})	0.71 (0.10)	0.87 (0.12)	1.03 (0.15)	1.20 (0.17)	1.44 (0.20)	1.68 (0.24)
Moving Mass (carriage and bearings) - kg(f) (lbs.)	0.23 (0.5)	0.30 (0.67)	0.38 (0.83)	0.45 (1.0)	0.53 (1.17)	0.61 (1.34)
Total Table Weight (without motors) - kg(f) (lbs.)	0.77 (1.7)	0.95 (2.1)	1.09 (2.4)	1.22 (2.7)	1.36 (3.0)	1.54 (3.4)
Top Speed — 40A screw — mm/s (inches/s)	13 (0.5)	13 (0.5)	13 (0.5)	13 (0.5)	13 (0.5)	13 (0.5)
Top Speed — 10A screw — mm/s (inches/s)	51 (2.0)	51 (2.0)	51 (2.0)	51 (2.0)	51 (2.0)	51 (2.0)
Top Speed — 5A screw — mm/s (inches/s)	102 (4.0)	102 (4.0)	102 (4.0)	102 (4.0)	102 (4.0)	102 (4.0)
Normal Load Capacity (max.)[2,3] - kg(f) (lbs.)	5.0 (11)	6.8 (16)	10.9 (24)	16.3 (36)	21.3 (47)	26.3 (58)
Inverted Load Capacity (max.)[2,3] - kg(f) (lbs.)	3.1 (6.8)	5.4 (11.9)	7.9 (17.4)	10.5 (23.1)	13.2 (29.1)	15.9 (35.1)
Side Load Capacity (max.)[2,3] - kg(f) (lbs.)	3.1 (6.8)	5.4 (11.9)	7.9 (17.4)	10.5 (23.1)	13.2 (29.1)	15.9 (35.1)
Axial Load Capacity (max.)[2,3] - kg(f) (lbs.)	±7.4 (16.3)	±7.4 (16.3)	±7.4 (16.3)	±7.4 (16.3)	±7.4 (16.3)	±7.4 (16.3)
Roll Moment Capacity (max.)[2,3] -Nm (ft-lb.)	±1.3 (1.0)	±2.4 (1.8)	±3.6 (2.7)	±4.5 (3.3)	±5.5 (4.1)	±6.8 (5.0)
Pitch Moment Capacity (max.)[2,3] -Nm (ft-lb.)	±1.3 (1.0)	±2.4 (1.8)	±3.6 (2.7)	±4.5 (3.3)	±5.5 (4.1)	±6.8 (5.0)
Yaw Moment Capacity (max.)[2,3] -Nm (ft-lb.)	±1.3 (1.0)	±2.4 (1.8)	±3.6 (2.7)	±4.5 (3.3)	±5.5 (4.1)	±6.8 (5.0)
Roll Deviation (max.)[2,3] — arc-sec	45	45	45	45	45	45
Yaw Deviation (max.)[2,3] — arc-sec	60	60	60	60	60	60
Pitch Deviation (max.)[2,3] — arc-sec	45	45	45	45	45	45
Nominal Straightness (max.)[2,3] — microns (inches)	12 (0.00048)	12 (0.00048)	12 (0.00048)	12 (0.00048)	12 (0.00048)	12 (0.00048)
Nominal Flatness (max.)[2,3] — microns (inches)	10 (0.00040)	10 (0.00040)	10 (0.00040)	10 (0.00040)	10 (0.00040)	10 (0.00040)
Bearing Life Calculation Constants (kg(f)) (Dynamic Capacity)	35	38	41	44	49	53

Drive Screw Data

	Diameter mm (inches)	Efficiency	Direction	Duty Cycle	Contouring Thrust Load (max.) kg(f) (lbs.)
40A	9.525 (0.375)	21%	Right Hand	60%	N/A
10A	9.525 (0.375)	53%	Right Hand	60%	N/A
5A	9.525 (0.375)	69%	Right Hand	60%	N/A

[2] Please consult IDC if your application requirements exceed catalog specifications.

[3] Based on the centerline of the table top.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications

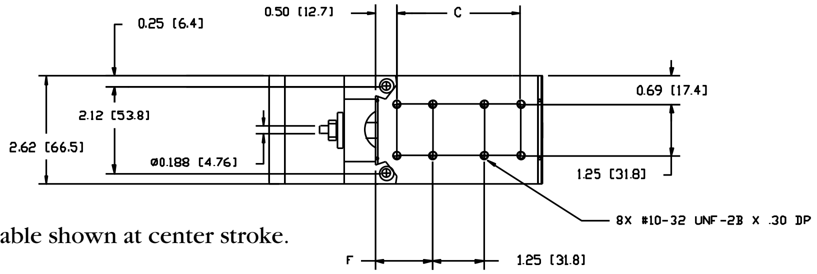
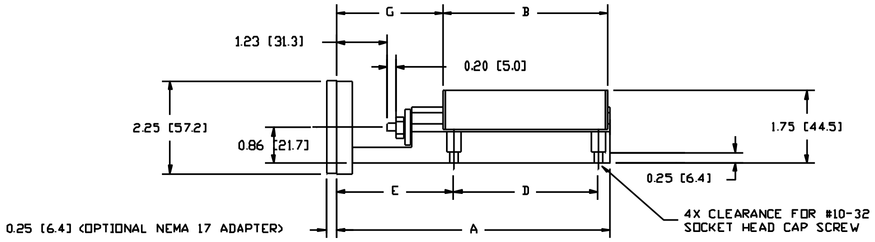
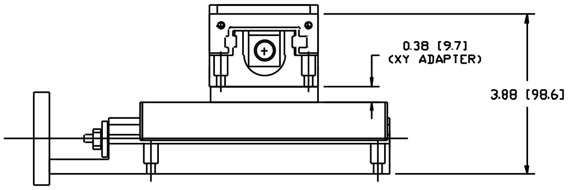
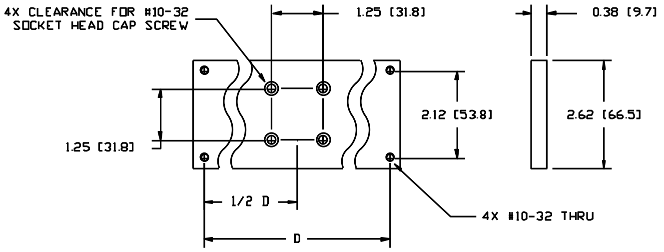


*Table shown at center stroke.





SPECIAL NOTE ON CP3 XY SYSTEMS: OVERALL SYSTEM HEIGHT AFFECTED AS SHOWN BY XY ADAPTER PLATE.



SPACER PLATES AVAILABLE FOR FLUSH MOUNTING OF ANY CP3 TRAVEL

Note:
1. NEMA 23 input standard (max coupling Ø.90 (22.86)).

Travel	A	B	C	D	E	F	G
1.00 (25.4)	5.63 (143.0)	3.00 (76.2)	2.00 (50.8)	2.50 (63.5)	2.83 (71.9)	0.88 (22.4)	2.58 (65.6)
2.00 (50.8)	6.63 (168.4)	4.00 (101.6)	3.00 (76.2)	3.50 (88.9)	2.83 (71.9)	1.38 (35.0)	2.58 (65.6)
3.00 (76.2)	7.63 (193.8)	5.00 (127.0)	4.00 (101.6)	4.50 (114.3)	2.83 (71.9)	1.88 (47.8)	2.58 (65.6)
4.00 (101.6)	8.63 (219.2)	6.00 (152.4)	5.00 (127.0)	5.50 (139.7)	2.83 (71.9)	2.38 (60.4)	2.58 (65.6)
5.00 (127.0)	10.13 (257.3)	7.00 (177.8)	6.00 (152.4)	6.50 (165.1)	3.33 (84.6)	2.88 (73.2)	3.07 (78.0)
6.00 (152.4)	11.63 (295.4)	8.00 (203.2)	7.00 (177.8)	7.50 (190.5)	3.83 (97.3)	3.38 (85.8)	3.58 (90.9)

Specifications

Basic Stepper Configuration

CP3R-___-10A-OE4-P21T-LX3-E0

Standard Precision Assembly
Precision Rolled Leadscrew (10A)
Travel (inches) 1, 2, 3, 4, 5 and 6
0.25 inch Oldham Coupling (OE4)
Performance Step Motor (P21)
3 Position External Limit Switches (LX3)
No Linear Encoder (E0)

(please refer to How to Order page for additional standard options)

Basic Servo Configuration

CP3R-___-10A-BE4-BN21-LX3-E0

Standard Precision Assembly
Precision Rolled Leadscrew (10A)
Travel (inches) 1, 2, 3, 4, 5 and 6
0.25 inch Bellows Coupling (BE4)
High Performance Servo Motor (BN21)
3 Position External Limit Switches (LX3)
No Linear Encoder (E0)

(please refer to How to Order page for additional standard options)

Make it an IDeal System

Include an IDC drive or control that is preconfigured for and tested with each Precision Table axis.
Stepper Choices: NextStep, SmartStep23, SmartStep, S6961 or S6962
Servo Choices: B8001, B8961 or B8962
(order as a separate line item)

Example:	CP3R-3-10A-OE4-P21T-LX3-E0	2
	CP3 XYP	1
	SMART STEP23	2
	IDEAL SYSTEM	2

(please refer to the IDeal System Section for further details)

Standard Multi-Axis Configuration

Standard Precision X-Y Mounting (XYP) — 20 arc-sec Orthogonality

(ordered as a separate line item to assemble 2 separate tables)

Example:	CP3R-4-10A-BE4-BN21-LX3-E0	2
	CP3 XYP	1

A 9.65mm (0.38 inch) Spacer Plate is necessary for a Precision XYP Assembly.

(for applications requiring more complicated assemblies than XYP, please refer to the Multi-Axis Section)

Standard Environmental Preparations

All standard IDC precision tables are designed to operate in general industrial environments.
Standard environmental preparation for Class 100 Clean Room or 10^{-7} Vacuum environments is also available.
(ordered as a separate line item per axis)

Example:	CP3R-2-10A-OE4-P21T-LX3-E0	2	Example:	CP3R-5-10A-BE4-BN21-LX3-E0	2
	CLEAN 100	2		VACUUM	2
	CP3 XYP	1		CP3 XYP	1

(for applications requiring other non-standard environments, please refer to the Environmental Section)

Performance Verification and Testing

(ordered as separate line item per axis)

Example:	CP3R-6-10A-OE4-P21T-LX3-E0	1
	TEST 1-1	1

(for applications requiring testing, please refer to the Performance Verification Section)

More Info?

More information, including a copy of the Owner's Manual is available by visiting IDC's web site or by contacting IDC.

How To Order

Ordering Example

CP3R	–	4	–	10A	–	0E4	–	P21T	–	LX3	–	E0
Model		Travel		Drive Screw		Coupling		Motor		Limit Switches		Linear Encoder

Product Model

CP3R	Standard Assembly

Travel (inches)

1, 2, 3, 4, 5, 6

Drive Screws
(see Drive Screw Section)

40A	0.635mm (0.025 inch) Precision Rolled Leadscrew Preloaded — Zero Backlash
10A	2.54mm (0.1 inch) Precision Rolled Leadscrew Preloaded — Zero Backlash
5A	5.08mm (0.2 inch) Precision Rolled Leadscrew Preloaded — Zero Backlash

Coupling — Type and Input Shaft
(see Coupling Section)

BE4	Stainless Steel Bellows 0.25 inch shaft diameter
BE5	Stainless Steel Bellows 0.3125 inch shaft diameter
OM5	Oldham 5mm shaft diameter
OE4	Oldham 0.25 inch shaft diameter
SM5	Stainless Steel Beam 5mm shaft diameter
SE4	Stainless Steel Beam 0.25 inch shaft diameter
SE5	Stainless Steel Beam 0.3125 inch shaft diameter

Motors - Stepper
(see Stepper Section on page G-1 and Motor Section)

S12n	Standard NEMA 17	(5mm coupling)
P21n	Performance NEMA 23	(0.25 inch coupling)
S21n	Standard NEMA 23	(0.25 inch coupling)
S22n	Standard NEMA 23	(0.25 inch coupling)

n = T (Series), V (Parallel), N (Flying leads)

Motors - Servo
(see Servo Section on page H-1 and Motor Section)

B12	Standard NEMA 17	(0.25 inch coupling)
BN21	Performance NEMA 23	(0.25 inch coupling)
BN23	Performance NEMA 23	(0.25 inch coupling)

Motors - Customer Supplied
(see Motor Section)

X17n	Standard NEMA 17 Motor Mount
X23n	Standard NEMA 23 Motor Mount

n = X Customer Supplied and Mounted
n = C Customer Supplied and IDC Mounted

Limit Switches
(see Limit Switch Section)

L0	No Limit Switches
LX2	2 Position External Hall Effect Limit Switch (2 over travel limit switches)
LX3	3 Position External Hall Effect Limit Switch (2 over travel limits & 1 home limit switch)

Encoders
(see Linear Encoder Section)

E0	No Linear Encoder
EM1	1 Micron Resolution
EM2	2 Micron Resolution
EMR	Standard Motor Mounted Rotary Encoder
EMKR	1000 Line Encoder (where available)

Special Features
(see preceding page)

(ordered as a separate line item)

Please contact IDC for non-standard applications or components.

Lead-times for complete positioning systems are determined by the lead-times of the individual components (precision tables, motors, gearmotors, drives and controls, etc.). Standard precision table lead-times apply to basic configurations and standard catalog options. Extended travels, environmental preparations, special components, special testing, special modifications and custom systems may require additional lead-time. Please contact IDC for further details.

Specifications

Note: Two CP8 tables are shown in a typical X-Y configuration.

Typical Applications

- High Precision Positioning
- Test and Inspection
- Gauging
- Light Duty Assembly
- Wafer Handling
- Alignment
- Light Load Pick and Place
- Scanning
- NOT Designed for Heavy Impact or Heavy Moment Loading
- NOT Designed for Vertical Applications

General Specifications

Materials	Top and base — black anodized aluminum alloy (6061 and cast tool plate); Ballscrew — DIN 1.6523 and 1.3505 steel; Cross roller bearings — 303 stainless steel; Leadscrew nut — acetal
Cross Section	203.2mm x 63.5mm (8 inches x 2.5 inches)
Travel Lengths (including limit switches)	127.0mm (5 inches), 177.8mm (7 inches), 228.6mm (9 inches) and 304.8mm (12 inches) (please refer to Travel Dependent Specifications)
Drive Screws	**Preloaded precision ground ballscrew — JIS C3 (zero backlash)** Nominal diameter 16mm (0.63 inches) **Preloaded precision rolled leadscrew (zero backlash)** Nominal Diameter 15.875mm (0.625 inches)
Ballscrew Lead Options	2.5mm (0.0984 inches), 5.08mm (0.2 inches) or 12.7mm (0.5 inches)
Leadscrew Lead Options	2.54mm (0.1 inches) or 5.08mm (0.2 inches) (please refer to Travel Dependent Specifications for maximum speeds)
Bearings	Precision non-recirculating cross roller bearings Nominal coefficient of friction 0.002 Special high precision assembly option available
Couplings	Bellows, Oldham or Stainless Steel Beam (please refer to Coupling Section)
Motors	Stepper (standard, T or V options) or Servo; Nominal NEMA 23 frame size (please refer to Stepper Section G-1, Servo Section H-1 and Motor Section)
Limit Switches	External Hall Effect switches — adjustable 3 position or 2 position — normally closed (please refer to Limit Switch Section)
Linear Encoder Resolution	1 micron (0.000039 inches) or 2 microns (0.000079 inches) (please refer to Linear Encoder Section)
Environment	General industrial, clean room or vacuum (please refer to Environmental Section)
Normal Ambient Temperature	20°C ± 15°C (68°F ± 27°F) — special high or low temperature preparation also available
Normal Ambient Pressure	760 torr — 10^{-3} torr (standard preparation) — up to 10^{-7} torr (special preparation)
Normal Cleanliness	Class 1000 (standard preparation) — up to Class 100 (special preparation)
Audible Noise (max.)	70 dB at top speed (1m away from positioning system)
Maximum Input Torque	125 oz-in

Specifications

Global Specifications

Ballscrew Accuracy Tolerance[1,2] (maximum lead error tolerance)	JIS C3 8 microns per 300mm — 6 microns per revolution 0.00032 inches per foot — 0.00024 inches per revolution JIS C1 5 microns per 300mm — 4 microns per revolution 0.00020 inches per foot — 0.00016 inches per revolution
Unidirectional Repeatability (max.)[1,2] (without linear encoder)	3 microns (0.00012 inches)
Bi-directional Repeatability (max.)[1,2] (without linear encoder)	6 microns (0.00024 inches)
Leadscrew Accuracy Tolerance (maximum lead error tolerance)	90 microns per 300mm — 7.5 microns per 25mm 0.0036 inches per foot — 0.0003 inches per inch
Unidirectional Repeatability (max.)[1,2]	5 microns (0.0002 inches)
Bi-directional Repeatability (max.)[1,2]	10 microns (0.0004 inches)
Limit Switch Repeatability[2]	50 microns (0.002 inches) (please refer to Limit Switch Section)
Breakaway Torque (max.)[2]	0.127 Nm (18 oz-in)
Running Torque (max.)[2]	0.106 Nm (15 oz-in)
Nominal Acceleration (max.)[2]	1.0 g — Ballscrew and Leadscrew
Duty Cycle	100% — Ballscrew 60% — Leadscrew
Nominal Straightness[2,3] (horizontal straightness) Precision Option	2 microns per 25mm (0.00008 inches per inch) Not to exceed travel dependent specifications 1 micron per 25mm (0.00004 inches per inch) Not to exceed travel dependent specifications
Nominal Flatness[2,3] (vertical straightness) Precision Option	2 microns per 25mm (0.00008 inches per inch) Not to exceed travel dependent specifications 1 micron per 25mm (0.00004 inches per inch) Not to exceed travel dependent specifications
Normal Load Stiffness[2,3]	1.8 kg(f) per micron (100,000 lbs. per inch)
Side Load Stiffness[2,3]	1.3 kg(f) per micron (70,000 lbs. per inch)
Axial Load Stiffness[2,3]	0.6 kg(f) per micron (30,000 lbs. per inch)
Roll Moment Compliance[2,3]	1.5 arc-sec per Nm (2 arc-sec per ft-lb.)
Pitch Moment Compliance[2,3]	1.5 arc-sec per Nm (2 arc-sec per ft-lb.)
Yaw Moment Compliance[2,3]	2.2 arc-sec per Nm (3 arc-sec per ft-lb.)
Precision X-Y Mounting Orthogonality (XYP)[2,3]	15 arc-sec

1 For applications requiring higher specification, interferometer testing, a higher accuracy ballscrew or a linear encoder may be necessary. Please refer to the Performance Verification Section and the Linear Encoder Section.

2 Please consult IDC if your application requirements exceed catalog specifications.

3 Based on the centerline of the table top.

All specifications are based on ISO 230-2 measurements of an unloaded, bolted down Precision Table with optimized motor tuning. These specifications were generated by measuring the peformance of a complete motion system that utilized IDC motors, drives and controls.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications

Travel Dependent Specifications

Standard Travels — Precision Assembly Option Available

(Travel includes space for limit switches)

	CP8-5	CP8-7	CP8-9	CP8-12
Travel — mm (inches)	127.0 (5)	177.8 (7)	228.6 (9)	304.8 (12)
Accuracy (error max.) - (ballscrew) - microns (inches) (leadscrew)	12 (0.00048) 20 (0.00080)	14 (0.00056) 24 (0.00096)	16 (0.00064) 28 (0.00112)	18 (0.00072) 30 (0.00120)
Inertia - kgm^{2}x10^{-6} (oz-in-s^{2}x10^{-3})	12.6 (1.8)	15.5 (2.2)	18.5 (2.6)	22.9 (3.2)
Moving Mass (carriage and bearings) — kg(f) (lbs.)	2.5 (5.6)	3.1 (6.9)	3.6 (7.9)	4.5 (9.9)
Total Table Weight (without motors) — kg(f) (lbs.)	5.9 (13)	6.8 (15)	8.2 (16)	9.1 (20)
Top Speed — 2.5MG screw — mm/s (inches/s)	201 (7.9)	201 (7.9)	201 (7.9)	139 (5.5)
Top Speed — 5G screw — mm/s (inches/s)	408 (16.1)	408 (16.1)	408 (16.1)	283 (11.2)
Top Speed — 2G screw — mm/s (inches/s)	N/A	N/A	1020 (40.2)	709 (27.9)
Top Speed — 10A screw —mm/s (inches/s)	86 (3.4)	86 (3.4)	86 (3.4)	59 (2.4)
Top Speed — 5A screw — mm/s (inches/s)	181 (7.1)	181 (7.1)	181 (7.1)	126 (4.9)
Normal Load Capacity (max.)[2,3] - kg(f) (lbs.)	99 (218)	107 (236)	119 (262)	127 (279)
Inverted Load Capacity (max.)[2,3] - kg(f) (lbs.)	49 (108)	54 (119)	60 (131)	64 (139)
Side Load Capacity (max.)[2,3] - kg(f) (lbs.)	±47 (104)	±51 (112)	±56 (124)	±61 (134)
Axial Load Capacity (max.)[2,3] - kg(f) (lbs.)	±26 (57)	±26 (57)	±26 (57)	±26 (57)
Roll Moment Capacity (max.)[2,3] -Nm (ft-lb.)	±81.3 (60)	±84.0 (62)	±86.8 (64)	±92.2 (68)
Pitch Moment Capacity (max.)[2,3] -Nm (ft-lb.)	±24 (17.7)	±37 (27.3)	±51 (37.6)	±72 (53.3)
Yaw Moment Capacity (max.)[2,3] -Nm (ft-lb.)	±24 (17.7)	±37 (27.3)	±51 (37.6)	±72 (53.3)
Roll Deviation (max.)[2,3] — arc-sec (precision)	10 (8)	15 (10)	20 (12)	25 (14)
Yaw Deviation (max.)[2,3] — arc-sec (precision)	30 (18)	34 (22)	38 (26)	42 (30)
Pitch Deviation (max.)[2,3] — arc-sec (precision)	16 (8)	20 (10)	24 (12)	28 (14)
Nominal Straightness (max.)[2,3] — microns (inches) Precision Assembly Option	10 (0.0004) 5 (0.0002)	10 (0.0004) 5 (0.0002)	10 (0.0004) 5 (0.0002)	10 (0.0004) 5 (0.0002)
Nominal Flatness (max.)[2,3] — microns (inches) Precision Assembly Option	10 (0.0004) 5 (0.0002)	12 (0.00048) 6 (0.00024)	14 (0.00056) 7 (0.00028)	16 (0.00064) 8 (0.00032)
Bearing Life Calculation Constants (kg(f)) (Dynamic Capacity)	198	219	246	279

Drive Screw Data

	Diameter mm (inches)	Efficiency	Direction	Duty Cycle	Contouring Thrust Load (max.) kg(f) (lbs.)
2.5MG	16 (0.63)	85%	Right Hand	100%	8.0 (17.6)
5G	16 (0.63)	90%	Right Hand	100%	12.0 (26.5)
2G	16 (0.63)	93%	Right Hand	100%	7.0 (15.4)
10A	15.875 (0.625)	41%	Right Hand	60%	N/A
5A	15.875 (0.625)	59%	Right Hand	60%	N/A

Life Calculation Constants (Dynamic Load Capacity)

(please refer to Bearing and Drivescrew Section)

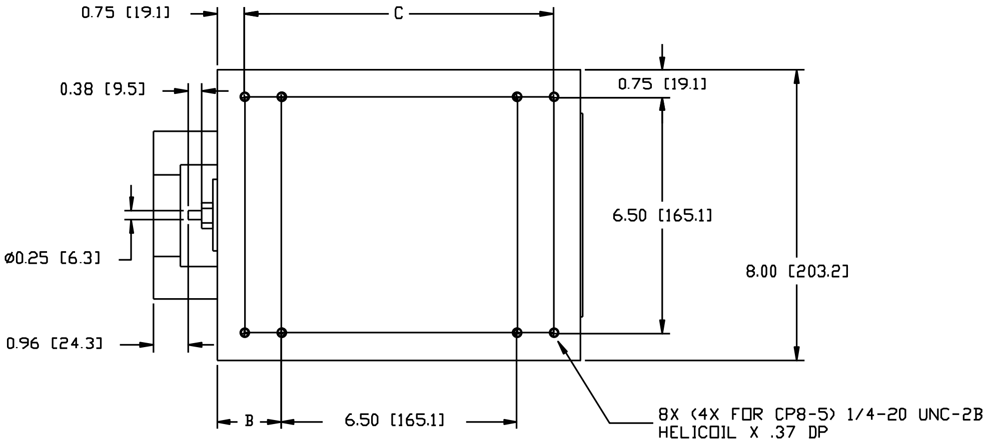
2.5MG Ballscrew	78 kg(f)
5G Ballscrew	232 kg(f)
2G Ballscrew	111 kg(f)

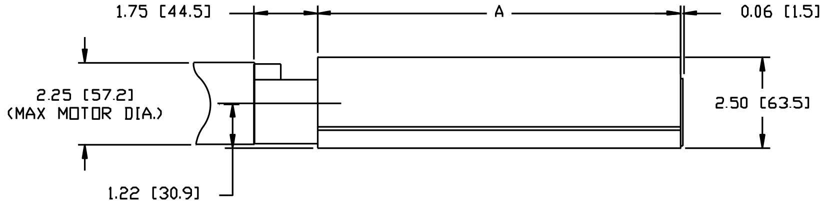
[2] Please consult IDC if your application requirements exceed catalog specifications.

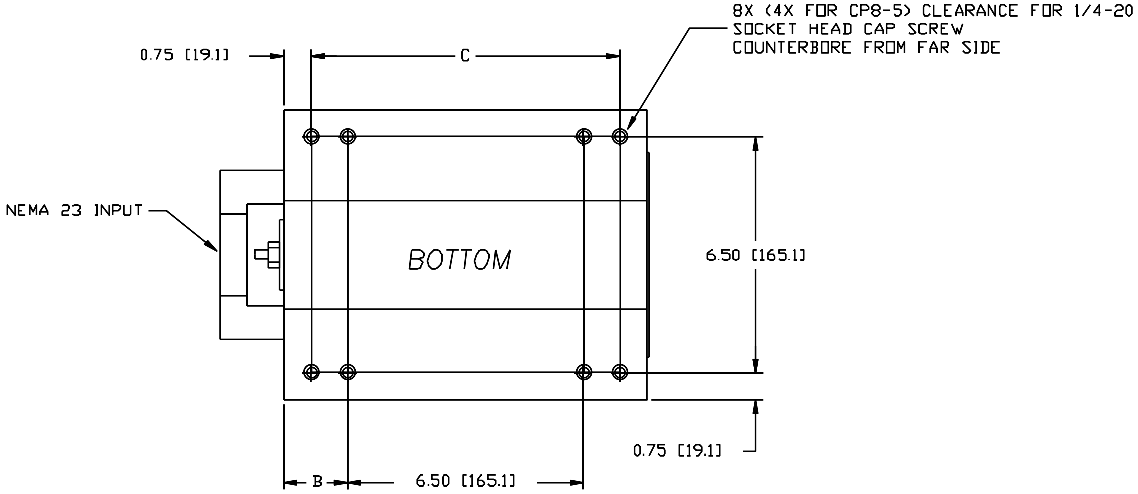
[3] Based on the centerline of the table top.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications







Travel	**A**	**B**	**C**
5.00 (127.0)	8.00 (202.2)	—	6.50 (152.4)
7.00 (177.8)	10.00 (254.0)	1.75 (44.4)	8.50 (215.9)
9.00 (228.6)	12.00 (304.8)	2.75 (69.8)	10.50 (266.7)
12.00 (304.8)	15.00 (381.0)	4.25 (108.0)	13.50 (342.9)

Specifications

Basic Stepper Configuration

CP8R-___-5G-OE4-P21T-LX3-E0

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 5, 7, 9 and 12
0.25 inch Oldham Coupling (OE4)

High Performance Step Motor (P21T)
3 Position External Limit Switches (LX3)
No Linear Encoder (E0)

(please refer to How to Order page for additional standard options)

Basic Servo Configuration

CP8R-___-5G-BE4-BN21-LX3-E0

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 5, 7, 9 and 12
0.25 inch Bellows Coupling (BE4)

High Performance Servo Motor (BN21)
3 Position External Limit Switches (LX3)
No Linear Encoder (E0)

(please refer to How to Order page for additional standard options)

Make it an IDeal System

Include an IDC drive or control that is preconfigured for and tested with each Precision Table axis.
Stepper Choices: NextStep, SmartStep23, SmartStep, S6961 or S6962
Servo Choices: B8001, B8961 or B8962
(order as a separate line item)

Example:	CP8R-7-5G-OE4-P21T-LX3-E0	2
	CP8 XYP	1
	SMART STEP23	2
	IDEAL SYSTEM	2

(please refer to the IDeal System Section for further details)

Standard Multi-Axis Configuration

Standard Precision X-Y Mounting (XYP) — 15 arc-sec Orthogonality — (dowel pinned assembly)

(ordered as a separate line item to assemble 2 separate tables)

Example:	CP8R-9-5G-BE4-BN21-LX3-E0	2
	CP8 XYP	1

(for applications requiring more complicated assemblies than XYP, please refer to the Multi-Axis Section)

Standard Environmental Preparations

All standard IDC precision tables are designed to operate in general industrial environments.
Standard environmental preparation for Class 100 Clean Room or 10^{-7} Vacuum environments is also available.
(ordered as a separate line item per axis)

Example:	CP8R-5-5G-OE4-P21T-LX3-E0	2
	CLEAN 100	2
	CP8 XYP	1

Example:	CP8R-7-5G-BE4-BN21-LX3-E0	2
	VACUUM	2
	CP8 XYP	1

(for applications requiring other non-standard environments, please refer to the Environmental Section)

Performance Verification and Testing

(ordered as separate line item per axis)

Example:	CP8R-12-5G-OE4-P21V-LX3-E0	1
	TEST 1-1	1

(for applications requiring testing, please refer to the Performance Verification Section)

More Info?

More information, including a copy of the Owner's Manual is available by visiting IDC's web site or by contacting IDC.

How To Order

Ordering Example

CP8R	7	5G	BE4	BN21	LX3	E0
Model	Travel	Drive Screw	Coupling	Motor	Limit Switches	Linear Encoder

Product Model

CP8R	Standard Assembly
CP8RP	Precision Assembly (lower angular errors)

Travel (inches)

5, 7, 9, 12

Drive Screws
(see Drive Screw Section)

2.5MG	2.5mm (0.0984 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash
5G	5.08mm (0.2 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash
2G	12.7mm (0.5 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash
2.5MGP	2.5mm (0.0984 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash
5GP	5.08mm (0.2 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash
2GP	12.7mm (0.5 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash
10A	2.54mm (0.1 inch) Precision Rolled Leadscrew Preloaded — Zero Backlash
5A	5.08mm (0.2 inch) Precision Rolled Leadscrew Preloaded — Zero Backlash

Coupling — Type and Input Shaft
(see Coupling Section)

BE4	Stainless Steel Bellows 0.25 inch shaft diameter
BE5	Stainless Steel Bellows 0.3125 inch shaft diameter
OE4	Oldham 0.25 inch shaft diameter
OE5	Oldham 0.3125 inch shaft diameter
SE4	Stainless Steel Beam 0.25 inch shaft diameter
SE5	Stainless Steel Beam 0.3125 inch shaft diameter

Motors - Stepper
(see Stepper Section on page G-1 and Motor Section)

P21n	Performance NEMA 23	(0.25 inch coupling)
P22n	Performance NEMA 23	(0.25 inch coupling)
S21n	Standard NEMA 23	(0.25 inch coupling)
S22n	Standard NEMA 23	(0.25 inch coupling)
S23n	Standard NEMA 23	(0.25 inch coupling)

n = T (Series), V (Parallel), N (Flying leads)

Motors - Servo
(see Servo Section on page H-1 and Motor Section)

BN21	Performance NEMA 23	(0.25 inch coupling)
BN23	Performance NEMA 23	(0.25 inch coupling)
B22	Standard NEMA 23	(0.3125 inch coupling)
B23	Standard NEMA 23	(0.3125 inch coupling)
B23H	Standard NEMA 23	(0.3125 inch coupling)

Motors - Customer Supplied
(see Motor Section)

X23n	Standard NEMA 23 Motor Mount

n = X Customer Supplied and Mounted
n = C Customer Supplied and IDC Mounted

Limit Switches
(see Limit Switch Section)

L0	No Limit Switches
LX2	2 Position External Hall Effect Limit Switch (2 over travel limit switches)
LX3	3 Position External Hall Effect Limit Switch (2 over travel limits & 1 home limit switch)

Encoders
(see Linear Encoder Section)

E0	No Linear Encoder
EM1	1 Micron Resolution
EM2	2 Micron Resolution
EMR	Standard Motor Mounted Rotary Encoder
EMKR	1000 Line Encoder (where available)

Special Features
(see preceding page)

(ordered as a separate line item)

Please contact IDC for non-standard applications or components.

Lead-times for complete positioning systems are determined by the lead-times of the individual components (precision tables, motors, gearmotors, drives and controls, etc.). Standard precision table lead-times apply to basic configurations and standard catalog options. Extended travels, environmental preparations, special components, special testing, special modifications and custom systems may require additional lead-time. Please contact IDC for further details.

Specifications

Typical Applications

- Pick and Place
- Inspection
- Alignment
- Assembly
- Deposition
- Light Load Contouring
- Dispensing
- Wafer Handling

General Specifications

Materials	Top and base — black anodized aluminum alloy (6061 and cast tool plate); Ballscrew and guideways — DIN 1.6523 and 1.3505 steel; Leadscrew nut — acetal
Cross Section	101.6mm x 63.5mm (4 inches x 2.5 inches)
Travel Lengths (including limits and covers)	50.8mm (2 inches), 101.6mm (4 inches), 152.4mm (6 inches), 203.2mm (8 inches), 304.8mm (12 inches) and 406.4mm (16 inches) (please refer to Travel Dependent Specifications)
Drive Screws	**Preloaded precision ground ballscrew — JIS C3 (zero backlash)** Nominal diameter 16mm (0.63 inches) **Preloaded precision rolled leadscrew (zero backlash)** Nominal diameter 15.875mm (0.625 inches)
Ballscrew Lead Options	2.5mm (0.0984 inches), 5.08mm (0.2 inches) or 12.7mm (0.5 inches)
Leadscrew Lead Options	2.54mm (0.1 inches) or 5.08mm (0.2 inches) (please refer to Travel Dependent Specifications for maximum speeds)
Bearings	Matched precision grade recirculating linear guideways Nominal coefficient of friction 0.008 Special high precision assembly option available
Couplings	Bellows, Oldham or Stainless Steel Beam (please refer to Coupling Section)
Motors	Stepper (standard, T or V options) or Servo Nominal NEMA 23 frame size (please refer to Stepper Section G-1, Servo Section H-1 and Motor Section)
Limit Switches	Internal Hall Effect switches — non-adjustable 3 position or 2 position — normally closed (please refer to Limit Switch Section)
Linear Encoder Resolution	1 micron (0.000039 inches) or 2 microns (0.000079 inches) (please refer to Linear Encoder Section)
Covers	Neoprene Bellows (Nominal IP 53)
Environment	General industrial, clean room or vacuum (please refer to Environmental Section)
Normal Ambient Temperature	20°C ± 15°C (68°F ± 27°F) — special high or low temperature preparation also available
Normal Ambient Pressure	760 torr — 10^{-3} torr (standard preparation) - up to 10^{-7} torr (special preparation)
Normal Cleanliness	Class 1000 (standard preparation) — up to Class 100 (special preparation)
Audible Noise (max.)	70 dB at top speed (1m away from positioning system)
Maximum Input Torque	120 oz-in

Specifications

Global Specifications

Ballscrew Accuracy Tolerance[1,2] (maximum lead error tolerance)	JIS C3 8 microns per 300mm — 6 microns per revolution 0.00032 inches per foot — 0.00024 inches per revolution JIS C1 5 microns per 300mm — 4 microns per revolution 0.00020 inches per foot — 0.00016 inches per revolution
Unidirectional Repeatability (max.)[1,2] (without linear encoder)	3 microns (0.00012 inches)
Bi-directional Repeatability (max.)[1,2] (without linear encoder)	6 microns (0.00024 inches)
Leadscrew Accuracy Tolerance (maximum lead error tolerance)	90 microns per 300mm — 7.5 microns per 25mm 0.0036 inches per foot — 0.0003 inches per inch
Unidirectional Repeatability (max.)[1,2]	5 microns (0.0002 inches)
Bi-directional Repeatability (max.)[1,2]	10 microns (0.0004 inches)
Limit Switch Repeatability[2]	50 microns (0.002 inches) (please refer to Limit Switch Section)
Breakaway Torque (max.)[2]	0.127 Nm (18 oz-in)
Running Torque (max.)[2]	0.106 Nm (15 oz-in)
Nominal Acceleration (max.)[2]	2.0 g — Ballscrew; 1.0 g — Leadscrew
Duty Cycle	100% — Ballscrew; 60% — Leadscrew
Normal Load Capacity (max.)[2]	±44 kg(f) (97 lbs.) (please refer to stiffness specifications)
Side Load Capacity (max.)[2]	±30 kg(f) (66 lbs.) (please refer to stiffness specifications)
Axial Load Capacity (max.)[2]	±14 kg(f) (30 lbs.) (please refer to stiffness specifications)
Roll Moment Capacity (max.)[2,3]	±59 Nm (44 ft-lb.) (please refer to compliance specifications)
Pitch Moment Capacity (max.)[2,3]	±47 Nm (35 ft-lb.) (please refer to compliance specifications)
Yaw Moment Capacity (max.)[2,3]	±66 Nm (49 ft-lb.) (please refer to compliance specifications)
Nominal Straightness[2] (horizontal straightness) Precision Option	2 microns per 25mm (0.00008 inches per inch) Not to exceed travel dependent specifications 1 micron per 25mm (0.00004 inches per inch) Not to exceed travel dependent specifications
Nominal Flatness[2] (vertical straightness) Precision Option	2 microns per 25mm (0.00008 inches per inch) Not to exceed travel dependent specifications 1 micron per 25mm (0.00004 inches per inch) Not to exceed travel dependent specifications
Normal Load Stiffness[2]	4.5 kg(f) per micron (250,000 lbs. per inch)
Side Load Stiffness[2]	3.6 kg(f) per micron (200,000 lbs. per inch)
Axial Load Stiffness[2]	0.5 kg(f) per micron (26,000 lbs. per inch)
Roll Moment Compliance[2]	2.2 arc-sec per Nm (3 arc-sec per ft-lb.)
Pitch Moment Compliance[2]	2.2 arc-sec per Nm (3 arc-sec per ft-lb.)
Yaw Moment Compliance[2]	3.7 arc-sec per Nm (5 arc-sec per ft-lb.)
Precision X-Y Mounting Orthogonality (XYP)[2]	15 arc-sec
Moving Mass (carriage and bearings)	1.2 kg(f) (2.5 lbs.)

[1] For applications requiring higher specification, interferometer testing, a higher accuracy ballscrew or a linear encoder may be necessary. Please refer to the Performance Verification Section and the Linear Encoder Section.

[2] Please consult IDC if your application requirements exceed catalog specifications.

[3] Based on the centerline of the table top.

All specifications are based on ISO 230-2 measurements of an unloaded, bolted down Precision Table with optimized motor tuning. These specifications were generated by measuring the peformance of a complete motion system that utilized IDC motors, drives and controls.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications

Travel Dependent Specifications

Standard Travels - Precision Assembly Option Available

(Travel includes space for limit switches and bellows)	RB4A-2	RB4A-4	RB4A-6
Travel — mm (inches)	50.8 (2)	101.6 (4)	152.4 (6)
Accuracy (error max.) — (ballscrew) — microns (inches)	12 (0.00048)	14 (0.00056)	16 (0.00064)
(leadscrew)	15 (0.0006)	30 (0.0012)	45 (0.0018)
Inertia — $\text{kgm}^2\text{x}10^{-6}$ ($\text{oz-in-s}^2\text{x}10^{-3}$)	16.6 (2.4)	19.6 (2.8)	22.6 (3.2)
Total Table Weight (without motors) — kg(f) (lbs.)	2.7 (6)	3.2 (7)	3.6 (8)
Top Speed — 2.5MG screw — mm/s (inches/s)	201 (7.9)	201 (7.9)	201 (7.9)
Top Speed — 5G screw — mm/s (inches/s)	408 (16.1)	408 (16.1)	408 (16.1)
Top Speed — 2G screw — mm/s (inches/s)	N/A	N/A	N/A
Top Speed — 10A screw — mm/s (inches/s)	86 (3.4)	86 (3.4)	86 (3.4)
Top Speed — 5A screw — mm/s (inches/s)	181 (7.1)	181 (7.1)	181 (7.1)
Roll Deviation (max.)[2,3] — arc-sec (precision)	16 (8)	18 (9)	20 (10)
Yaw Deviation (max.)[2,3] — arc-sec (precision)	16 (8)	20 (10)	24 (12)
Pitch Deviation (max.)[2,3] — arc-sec (precision)	16 (8)	18 (9)	20 (10)
Nominal Straightness (max.)[2,3] — microns (inches)	8 (0.00032)	8 (0.00032)	8 (0.00032)
Precision Assembly Option	4 (0.00016)	4 (0.00016)	4 (0.00016)
Nominal Flatness (max.)[2,3] — microns (inches)	8 (0.00032)	10 (0.0004)	12 (0.00048)
Precision Assembly Option	4 (0.00016)	5 (0.0002)	6 (0.00024)

Standard Travels - Precision Assembly Option Available

(Travel includes space for limit switches and bellows)	RB4A-8	RB4A-12	RB4A-16
Travel — mm (inches)	203.2 (8)	304.8 (12)	406.4 (16)
Accuracy (error max.) — (ballscrew) — microns (inches)	18 (0.00072)	20 (0.00080)	22 (0.00088)
(leadscrew)	50 (0.0024)	90 (0.0036)	120 (0.0048)
Inertia — $\text{kgm}^2\text{x}10^{-6}$ ($\text{oz-in-s}^2\text{x}10^{-3}$)	25.5 (3.6)	31.5 (4.5)	37.3 (5.3)
Total Table Weight (without motors) — kg(f) (lbs.)	4.1 (9)	5.0 (11)	5.9 (13)
Top Speed — 2.5MG screw — mm/s (inches/s)	201 (7.9)	201 (7.9)	154 (6.1)
Top Speed — 5G screw — mm/s (inches/s)	408 (16.1)	408 (16.1)	312 (12.3)
Top Speed — 2G screw — mm/s (inches/s)	1020 (40.2)	1020 (40.2)	781 (30.8)
Top Speed — 10A screw — mm/s (inches/s)	86 (3.4)	86 (3.4)	66 (2.6)
Top Speed — 5A screw — mm/s (inches/s)	181 (7.1)	181 (7.1)	139 (5.5)
Roll Deviation (max.)[2,3] — arc-sec (precision)	22 (11)	24 (12)	26 (13)
Yaw Deviation (max.)[2,3] — arc-sec (precision)	28 (14)	32 (16)	36 (18)
Pitch Deviation (max.)[2,3] — arc-sec (precision)	22 (11)	24 (12)	26 (13)
Nominal Straightness (max.)[2,3] — microns (inches)	10 (0.00040)	12 (0.00048)	14 (0.00056)
Precision Assembly Option	5 (0.00020)	6 (0.00024)	7 (0.00028)
Nominal Flatness (max.)[2,3] — microns (inches)	14 (0.00056)	16 (0.00064)	18 (0.00072)
Precision Assembly Option	7 (0.00028)	8 (0.00032)	9 (0.00036)

Drive Screw Data

	Diameter mm (inches)	Efficiency	Direction	Duty Cycle	Contouring Thrust Load (max.) kg(f) (lbs.)
2.5MG	16 (0.63)	85%	Right Hand	100%	8.0 (17.6)
5G	16 (0.63)	90%	Right Hand	100%	12.0 (26.5)
2G	16 (0.63)	93%	Right Hand	100%	7.0 (15.4)
10A	15.875 (0.625)	41%	Right Hand	60%	N/A
5A	15.875 (0.625)	59%	Right Hand	60%	N/A

Life Calculation Constants (Dynamic Load Capacity)

(please refer to Bearing and Drivescrew Section)

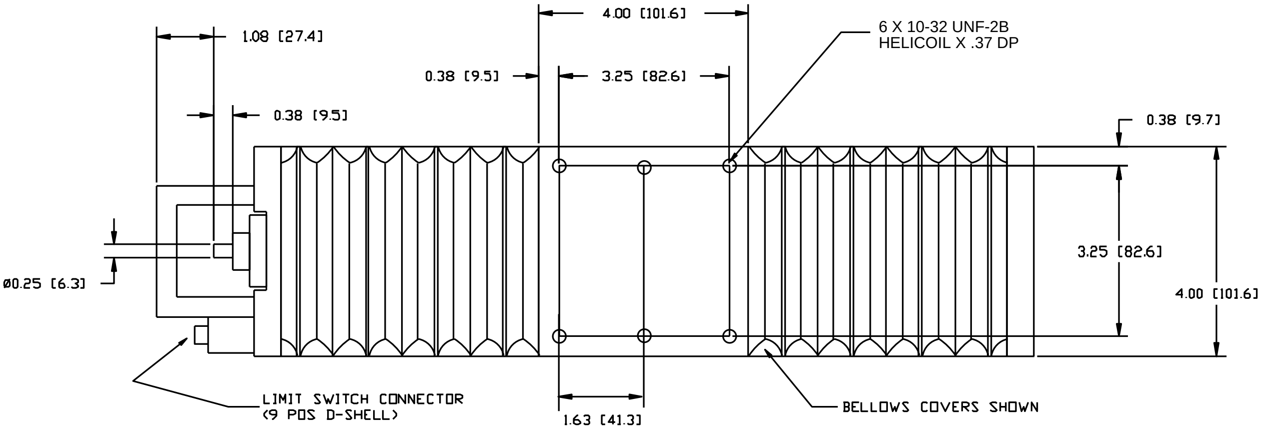
Bearings	190 kg(f)
2.5MG Ballscrew	78 kg(f)
5G Ballscrew	232 kg(f)
2G Ballscrew	111 kg(f)

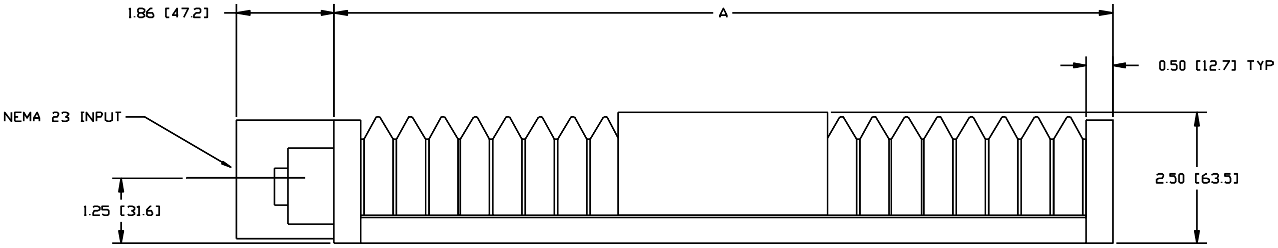
[2] Please consult IDC if your application requirements exceed catalog specifications.

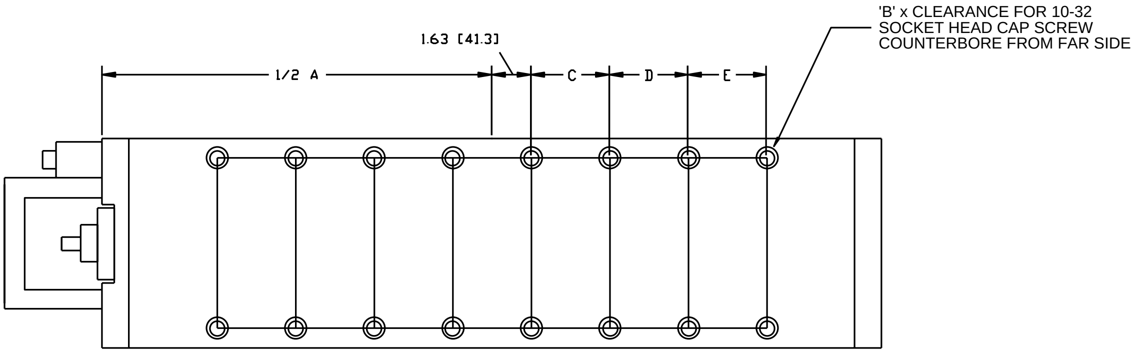
[3] Based on the centerline of the table top.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications







Travel	A	B	C	D	E
2.00 (50.8)	8.31 (211.1)	4	—	—	—
4.00 (101.6)	10.62 (269.7)	4	—	—	—
6.00 (152.4)	12.93 (328.4)	8	3.25 (82.6)	—	—
8.00 (203.2)	15.24 (387.1)	8	3.25 (82.6)	—	—
12.00 (304.8)	19.72 (500.9)	12	3.25 (82.6)	3.25 (82.6)	—
16.00 (406.4)	24.34 (618.2)	16	3.25 (82.6)	3.25 (82.6)	3.25 (82.6)

Specifications

Basic Stepper Configuration

RB4A-___-5G-OE4-P21T-LI3-E0-CV1

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 2, 4, 5, 12 and 16
0.25 inch Oldham Coupling (OE4)

High Performance Step Motor (P21)
3 Position Internal Limit Switches (LI3)
No Linear Encoder (E0)
Neoprene Bellows Cover (CV1)

(please refer to How to Order page for additional standard options)

Basic Servo Configuration

RB4A-___-5G-BE4-BN21-LI3-E0-CV1

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 2, 4, 6, 8, 12 and 16
0.25 inch Bellows Coupling (BE4)

High Performance Servo Motor (BN21)
3 Position Internal Limit Switches (LI3)
No Linear Encoder (E0)
Neoprene Bellows Cover (CV1)

(please refer to How to Order page for additional standard options)

Make it an IDeal System

Include an IDC drive or control that is preconfigured for and tested with each Precision Table axis.
Stepper Choices: NextStep, SmartStep23, SmartStep, S6961 or S6962
Servo Choices: B8001, B8961 or B8962
(order as a separate line item)

Example:	RB4A-6-5G-OE4-P21T-LI3-E0-CV1	2
	RB4A XYP	1
	SMART STEP23	2
	IDEAL SYSTEM	2

(please refer to the IDeal System Section for further details)

Standard Multi-Axis Configuration

Standard Precision X-Y Mounting (XYP) — 15 arc-sec Orthogonality — (dowel pinned assembly)

(ordered as a separate line item to assemble 2 separate tables)

Example:	RB4A-8-5G-BE4-BN21-LI3-E0-CV1	2
	RB4A XYP	1

(for applications requiring more complicated assemblies than XYP, please refer to the Multi-Axis Section)

Standard Environmental Preparations

All standard IDC precision tables are designed to operate in general industrial environments.
Standard environmental preparation for Class 100 Clean Room or 10^{-7} Vacuum environments is also available.
(ordered as a separate line item per axis)

Example:	RB4A-12-5G-OE4-P21T-LI3-E0-CV0	2	Example:	RB4A-4-5G-BE4-BN21-LI3-E0-CV0	2
	CLEAN 100	2		VACUUM	2
	RB4A XYP	1		RB4A XYP	1

(for applications requiring other non-standard environments, please refer to the Environmental Section)

Performance Verification and Testing

(ordered as separate line item per axis)

Example:	RB4A-16-5G-OE4-P21T-LI3-E0-CV1	1
	TEST 1-1	1

(for applications requiring testing, please refer to the Performance Verification Section)

More Info?

More information, including a copy of the Owner's Manual is available by visiting IDC's web site or by contacting IDC.

How To Order

Ordering Example

RB4A	4	5G	BE4	BN21	LI3	E0	CV1
Model	Travel	Drive Screw	Coupling	Motor	Limit Switches	Linear Encoder	Covers

Product Model

RB4A	Standard Assembly
RB4AP	Precision Assembly (lower angular errors)

Travel (inches)

2, 4, 6, 8, 12, 16

Drive Screws
(see Drive Screw Section)

2.5MG	2.5mm (0.0984 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash
5G	5.08mm (0.2 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash
2G	12.7mm (0.5 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash
2.5MGP	2.5mm (0.0984 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash
5GP	5.08mm (0.2 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash
2GP	12.7mm (0.5 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash
10A	2.54mm (0.1 inch) Precision Rolled Leadscrew Preloaded — Zero Backlash
5A	5.08 (0.2 inch) Precision Rolled Leadscrew Preloaded — Zero Backlash

Coupling — Type and Input Shaft
(see Coupling Section)

BE4	Stainless Steel Bellows 0.25 inch shaft diameter
BE5	Stainless Steel Bellows 0.3125 inch shaft diameter
OE4	Oldham 0.25 inch shaft diameter
OE5	Oldham 0.3125 inch shaft diameter
SE4	Stainless Steel Beam 0.25 inch shaft diameter
SE5	Stainless Steel Beam 0.3125 inch shaft diameter

Motors - Stepper
(see Stepper Section on page G-1 and Motor Section)

P21n	Performance NEMA 23	(0.25 inch coupling)
P22n	Performance NEMA 23	(0.25 inch coupling)
S21n	Standard NEMA 23	(0.25 inch coupling)
S22n	Standard NEMA 23	(0.25 inch coupling)
S23n	Standard NEMA 23	(0.25 inch coupling)

n = T (Series), V (Parallel), N (Flying leads)

Motors - Servo
(see Servo Section on page H-1 and Motor Section)

BN21	Performance NEMA 23	(0.25 inch coupling)
BN23	Performance NEMA 23	(0.25 inch coupling)
B22	Standard NEMA 23	(0.3125 inch coupling)
B23	Standard NEMA 23	(0.3125 inch coupling)
B23H	Standard NEMA 23	(0.3125 inch coupling)

Motors - Customer Supplied
(see Motor Section)

X23n	Standard NEMA 23 Motor Mount

n = X Customer Supplied and Mounted
n = C Customer Supplied and IDC Mounted

Limit Switches
(see Limit Switch Section)

L0	No Limit Switches
LI2	2 Position Internal Hall Effect Limit Switch (2 over travel limit switches)
LI3	3 Position Internal Hall Effect Limit Switch (2 over travel limits & 1 home limit switch)

Encoders
(see Linear Encoder Section)

E0	No Linear Encoder
EM1	1 Micron Resolution
EM2	2 Micron Resolution
EMR	Standard Motor Mounted Rotary Encoder
EMKR	1000 Line Encoder (where available)

Covers *(see Cover Section)*

CV0	No Covers
CV1	Neoprene Bellows Cover

Special Features *(see preceding page)*

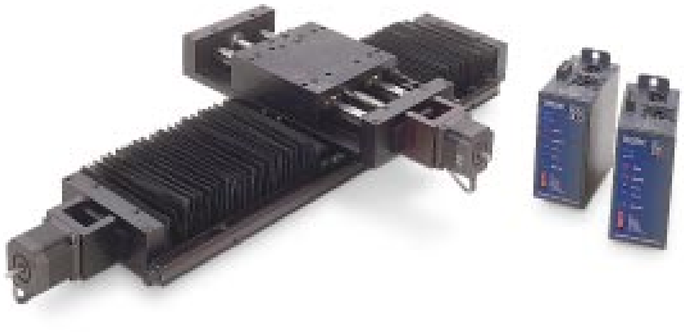
(ordered as a separate line item)

Special Options *(see Specials Section)*

Please contact IDC for non-standard applications or components.

Lead-times for complete positioning systems are determined by the lead-times of the individual components (precision tables, motors, gearmotors, drives and controls, etc.). Standard precision table lead-times apply to basic configurations and standard catalog options. Extended travels, environmental preparations, special components, special testing, special modifications and custom systems may require additional lead-time. Please contact IDC for further details.

Specifications



Note: Two RB6 tables are shown in a typical X-Y configuration.

Typical Applications

- Pick and Place
- Inspection
- Assembly
- Deposition
- Contouring
- Laser Cutting
- Dispensing
- Light Machining

General Specifications

Materials	Top and base — black anodized aluminum alloy (6061 and cast tool plate); Ballscrew and guideways — DIN 1.6523 and 1.3505 steel
Cross Section	152.4mm x 88.9mm (8 inches x 3.5 inches)
Travel Lengths (including limits and covers)	**Standard** — 152.4mm (6 inch), 304.8mm (12 inch), 457.2mm (18 inch) and 609.6mm (24 inch) **Extended** — 762.0mm (30 inch), 914.4mm (36 inch), 1066.8mm (42 inch), and 1219.2mm (48 inch)
Drive Screw	Preloaded precision ground ballscrew — JIS C3 and C5 (zero backlash) Nominal diameter 20mm (0.7874 inch)
Ballscrew Lead Options	5.08mm (0.2 inch), 10mm (0.3937 inch), or 20mm (0.7874 inch) (please refer to Travel Dependent Specifications for maximum speeds)
Bearings	Matched precision grade recirculating linear guideways Nominal coefficient of friction 0.008 Special high precision assembly option available for standard travels only
Couplings	Bellows, Oldham, or Stainless Steel Beam (please refer to Coupling Section)
Motors	Stepper (standard, T or V options) or Servo; Nominal NEMA 23 or NEMA 34 frame sizes (please refer to Stepper Section G-1, Servo Section H-1 and Motor section)
Limit Switches	Internal Hall Effect switches — non-adjustable 3 position or 2 position — normally closed (please refer to Limit Switch Section)
Linear Encoder Resolution	1 micron (0.000039 inch) or 2 microns (0.000079 inch) (please refer to Linear Encoder Section)
Covers	Neoprene bellows (Nominal IP 53)
Environment	General industrial, clean room, or vacuum (please refer to Environmental Section)
Normal Ambient Temperature	20°C ± 15°C (68°F ± 27°F) — special high or low temperature preparation also available
Normal Ambient Pressure	760 torr — 10^{-3} torr (standard preparation) — up to 10^{-7} torr (special preparation)
Normal Cleanliness	Class 1000 (standard preparation) — up to Class 100 (special preparation)
Audible Noise (max.)	70 dB at top speed (1m away from positioning system)
Maximum Input Torque	300 oz-in

Specifications

Global Specifications

Ballscrew Accuracy Tolerances[1,2] (maximum lead error tolerance)	**Travel of 600mm (24 inches) or less — JIS C3** 8 microns per 300mm — 6 microns per revolution 0.00032 inch per foot — 0.00024 inch per revolution **Travel of 600mm (24 inches) or less — JIS C1** 5 microns per 300mm — 4 microns per revolution 0.00020 inch per foot — 0.00016 inch per revolution **Travel greater than 600mm (24 inches) — JIS C5** 18 microns per 300mm — 8 microns per revolution 0.00072 inch per foot — 0.00032 inch per revolution
Unidirectional Repeatability (max.)[1,2] (without linear encoder)	**Travel 600mm (24 inches) or less** 3 microns (0.00012 inch) **Travel greater than 600mm (24 inches)** 4 microns (0.00016 inch)
Bi-directional Repeatability (max.)[1,2] (without linear encoder)	**Travel 600mm (24 inches) or less** 6 microns (0.00024 inch) **Travel Greater than 600mm (24 inches)** 8 microns (0.00032 inch)
Limit Switch Repeatability[2]	50 microns (0.002 inch) (please refer to Limit Switch Section)
Breakaway Torque (max.)[2]	0.141 Nm (20 oz-in)
Running Torque (max.)[2]	0.127 Nm (18 oz-in)
Nominal Acceleration (max.)[2]	2.0 g
Duty Cycle	100%
Normal Load Capacity (max.)[2,3]	±193 kg(f) (425 lbs.) (please refer to stiffness specifications)
Side Load Capacity (max.)[2,3]	±141 kg(f) (310 lbs.) (please refer to stiffness specifications)
Axial Load Capacity (max.)[2,3]	±47 kg(f) (110 lbs.) (please refer to stiffness specifications)
Roll Moment Capacity (max.)[2,3]	±133 Nm (96 ft-lb) (please refer to stiffness specifications)
Pitch Moment Capacity (max.)[2,3]	±106 Nm (77.5 ft-lb) (please refer to stiffness specifications)
Yaw Moment Capacity (max.)[2,3]	±71 Nm (52 ft-lb) (please refer to stiffness specifications)
Nominal Straightness[2,3] (horizontal straightness) Precision Option (standard travels only)	2 microns per 25mm (0.00008 inch per inch) Not to exceed travel dependent specifications 1 micron per 25mm (0.00004 inch per inch) Not to exceed travel dependent specifications
Nominal Flatness[2,3] (vertical straightness) Precision Option (standard travels only)	2 microns per 25mm (0.00008 inch per inch) Not to exceed travel dependent specifications 1 micron per 25mm (0.00004 inch per inch) Not to exceed travel dependent specifications
Normal Load Stiffness[2,3]	5.5 kg(f) per micron (300,000 lbs. per inch)
Side Load Stiffness[2,3]	4.0 kg(f) per micron (225,000 lbs. per inch)
Axial Load Stiffness[2,3]	0.65 kg(f) per micron (35,000 lbs. per inch)
Roll Moment Compliance[2,3]	0.75 arc-sec per Nm (1 arc-sec per ft-lb)
Pitch Moment Compliance[2,3]	0.75 arc-sec per Nm (1 arc-sec per ft-lb)
Yaw Moment Compliance[2,3]	1.5 arc-sec per Nm (2 arc-sec per ft-lb)
Precision X-Y Mounting Orthogonality (XYP)[2,3]	15 arc-sec
Moving Mass (carriage and bearing)	2.75 kg(f) (6 lbs.)

1 For applications requiring higher specification, interferometer testing, a higher accuracy ballscrew or a linear encoder may be necessary. Please refer to the Performance Verification Section and the Linear Encoder Section.

2 Please consult IDC if your application requirements exceed catalog specifications.

3 Based on the centerline of the table top.

All specifications are based on ISO 230-2 measurements of an unloaded, bolted down Precision Table with optimized motor tuning. These specifications were generated by measuring the peformance of a complete motion system that utilized IDC motors, drives and controls.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Travel Dependent Specifications

Standard Travels — Precision Assembly Option Available

(Travel includes space for limit switches and bellows)

	RB6-6	RB6-12	RB6-18	RB6-24
Travel — mm (inches)	152.4 (6)	304.8 (12)	457.2 (18)	609.6 (24)
Accuracy (error max.) — microns (inches)	12 (0.00048)	14 (0.00056)	16 (0.00064)	18 (0.00072)
Inertia — kgm^{2}x10^{-6} (oz-in-s^{2}x10^{-3})	71.6 (10.1)	94.3 (13.4)	117.0 (16.6)	139.7 (19.8)
Total Table Weight (without motors) — kg(f) (lbs.)	10.9 (24)	12.3 (27)	15.0 (33)	16.3 (36)
Top Speed — 5G screw — mm/s (inches/s)	322 (12.7)	322 (12.7)	268 (10.6)	183 (7.2)
Top Speed — 10MG screw — mm/s (inches/s)	635 (25.0)	635 (25.0)	528 (20.8)	361 (14.2)
Top Speed — 20MG screw — mm/s (inches/s)	1270 (50.0)	1270 (50.0)	1056 (41.6)	722 (28.4)
Roll Deviation (max.)[2,3] — arc-sec (precision)	16 (8)	18 (9)	20 (10)	24 (12)
Yaw Deviation (max.)[2,3] — arc-sec (precision)	16 (8)	18 (9)	20 (10)	24 (12)
Pitch Deviation (max.)[2,3] — arc-sec (precision)	16 (8)	18 (9)	20 (10)	24 (12)
Nominal Straightness (max.)[2,3] — microns (inches) Precision Assembly Option	12 (0.00048) 6 (0.00024)	16 (0.00064) 8 (0.00032)	20 (0.00080) 10 (0.00040)	24 (0.00096) 12 (0.00048)
Nominal Flatness (max.)[2,3] — microns (inches) Precision Assembly Option	12 (0.00048) 6 (0.00024)	16 (0.00064) 8 (0.00032)	20 (0.00080) 10 (0.00040)	24 (0.00096) 12 (0.00048)

Standard Travels — Precision Assembly Option Not Available

(Travel includes space for limit switches and bellows)

	RB6-30	RB6-36	RB6-42	RB6-48
Travel — mm (inches)	762.0 (30)	914.4 (36)	1086.8 (42)	1219.2 (48)
Accuracy (error max.) — microns (inches)	24 (0.00096)	28 (0.00112)	32 (0.00128)	36 (0.00144)
Inertia — kgm^{2}x10^{-6} (oz-in-s^{2}x10^{-3})	153.9 (21.8)	176.6 (25.0)	199.3 (28.2)	222.0 (31.4)
Total Table Weight (without motors) — kg(f) (lbs.)	19.0 (42)	20.4 (45)	23.1 (51)	24.5 (54)
Top Speed — 5G screw — mm/s (inches/s)	149 (5.9)	112 (4.4)	87 (3.4)	69 (2.7)
Top Speed — 10MG screw — mm/s (inches/s)	294 (11.6)	220 (8.7)	171 (6.7)	139 (5.4)
Top Speed — 20MG screw — mm/s (inches/s)	588 (23.3)	440 (17.3)	341 (13.4)	272 (10.7)
Roll Deviation (max.)[2,3] — arc-sec	40	45	50	55
Yaw Deviation (max.)[2,3] — arc-sec	40	45	50	55
Pitch Deviation (max.)[2,3] — arc-sec	40	45	50	55
Nominal Straightness (max.)[2,3] — microns (inches)	28 (0.00112)	32 (0.00128)	36 (0.00144)	40 (0.00160)
Nominal Flatness (max.)[2,3] — microns (inches)	28 (0.00112)	32 (0.00128)	36 (0.00144)	40 (0.00160)

Ballscrew Data

	Diameter mm (inches)	Efficiency	Direction	Duty Cycle	Contouring Thrust Load (max.) kg(f) (lbs.)
5G	20 (0.7874)	87%	Right Hand	100%	10.0 (22.0)
10MG	20 (0.7874)	90%	Right Hand	100%	7.0 (15.4)
20MG	20 (0.7874)	93%	Right Hand	100%	5.0 (11.0)

Life Calculation Constants (Dynamic Load Capacity)

(please refer to Bearing and Drivescrew Section)

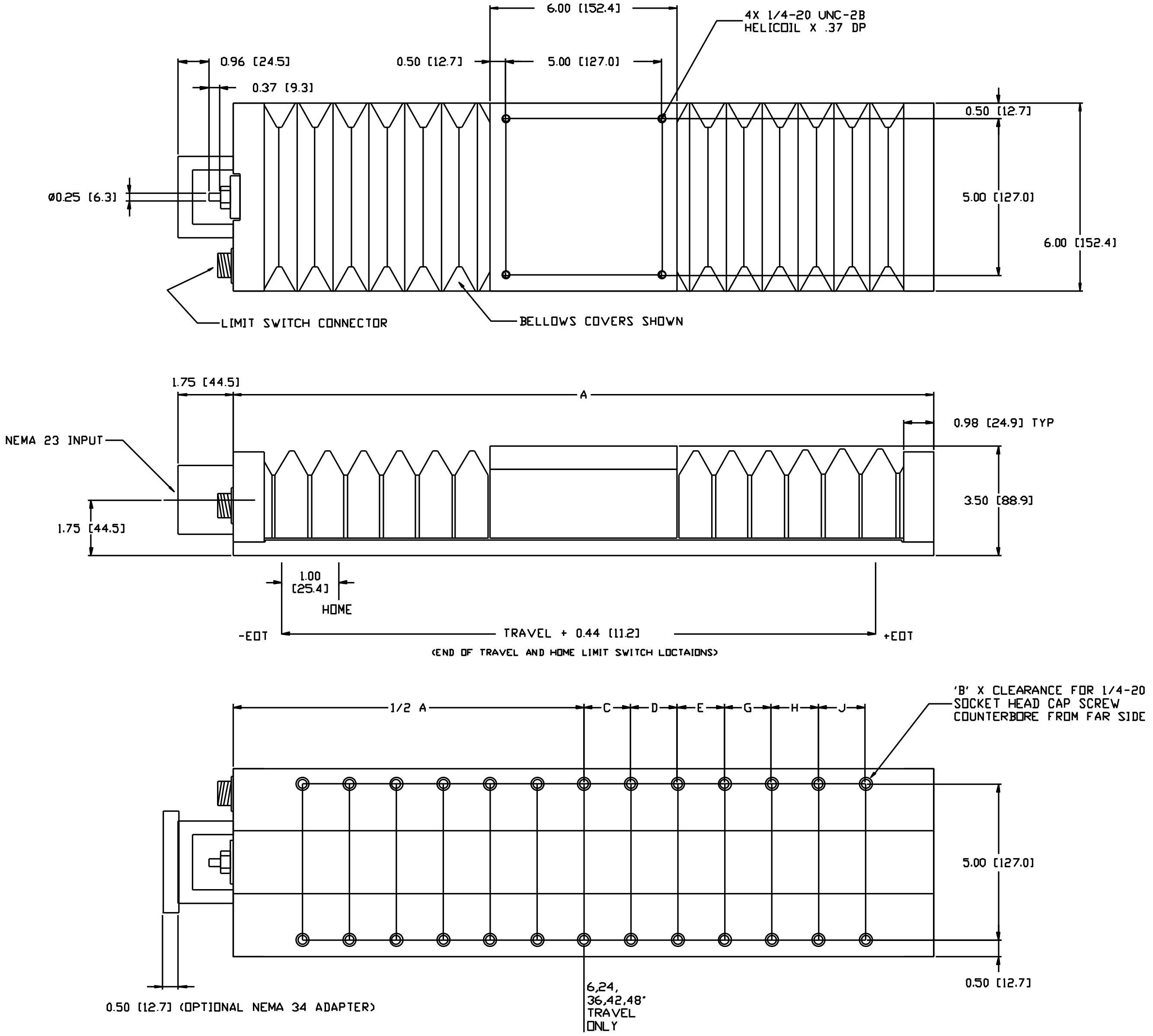
Bearings	640 kg(f)
5G Ballscrew	317 kg(f)
10MG Ballscrew	232 kg(f)
20MG Ballscrew	136 kg(f)

[2] Please consult IDC if your application requirements exceed catalog specifications.

[3] Based on the centerline of the table top.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications



Travel	A	B	C	D	E	G	H	J
6.00 (152.4)	16.32 (414.5)	10	2.50 (63.5)	2.50 (63.5)	—	—	—	—
12.00 (304.8)	22.40 (881.9)	8	2.50 (63.5)	5.00 (127.0)	—	—	—	—
18.00 (457.2)	29.14 (740.2)	12	2.50 (63.5)	5.00 (127.0)	5.00 (127.0)	—	—	—
24.00 (609.6)	36.18 (919.0)	14	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	—	—	—
30.00 (762.0)	43.18 (1096.8)	16	2.50 (63.5)	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	—	—
36.00 (914.4)	50.15 (1273.8)	18	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	—	—
42.00 (1066.8)	56.91 (1445.5)	22	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	—
48.00 (1219.2)	63.65 (1616.7)	26	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)

Specifications

Basic Stepper Configuration

RB6-___-5G-OE4-P22T-LI3-E0-CV1

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 6, 12, 18, and 24
0.25 inch Oldham Coupling (OE4)

High Performance Step Motor (P22T)
3 Position Internal Limit Switches (LI3)
No Linear Encoder (E0)
Neoprene Bellows Covers (CV1)

(please refer to How to Order page for additional standard options)

Basic Servo Configuration

RB6-___-5G-BE4-BN23-LI3-E0-CV1

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 6, 12, 18, and 24
0.25 inch Bellows Coupling (BE4)

High Performance Servo Motor (BN23)
3 Position Internal Limit Switches (LI3)
No Linear Encoder (E0)
Neoprene Bellows Covers (CV1)

(please refer to How to Order page for additional standard options)

Make it an IDeal System

Include an IDC drive or control that is preconfigured for and tested with each Precision Table axis.
Stepper Choices: NextStep, SmartStep23, SmartStep, S6961 or S6962
Servo Choices: B8001, B8961 or B8962
(order as a separate line item)

Example:	RB6-18-5G-OE4-P22T-L13-EO-CV1	2
	RB6 XYP	1
	SMART STEP23	2
	IDEAL SYSTEM	2

(please refer to the IDeal System Section for further details)

Standard Multi-Axis Configuration

Standard Precision X-Y Mounting (XYP) — 15 arc-sec Orthogonality — (dowel pinned assembly)
(ordered as a separate line item to assemble 2 separate tables)

Example:	RB6-12-5G-BE4-BN23-LI3-E0-CV1	2
	RB6 XYP	1

(for applications requiring more complicated assemblies than XYP, please refer to the Multi-Axis Section)

Standard Environmental Preparations

All standard IDC precision tables are designed to operate in general industrial environments.
Standard environmental preparation for Class 100 Clean Room or 10^{-7} Vacuum environments is also available.
(ordered as a separate line item per axis)

Example:	RB6-18-5G-BE4-BN23-LI3-E0-CV0	2	Example:	RB6-6-5G-BE4-BN23-LI3-E0-CV0	2
	CLEAN 100	2		VACUUM	2
	RB6 XYP	1		RB6 XYP	1

(for applications requiring other non-standard environments, please refer to the Environmental Section)

Performance Verification and Testing

(ordered as separate line item per axis)

Example:	RB6-24-5G-OE4-P22V-LI3-E0-CV1	1
	TEST 1-1	1

(for applications requiring testing, please refer to the Performance Verification Section)

More Info?

More information, including a copy of the Owner's Manual is available by visiting IDC's web site or by contacting IDC.

How To Order

Ordering Example

RB6	–	24	–	5G	–	BE4	–	BN23	–	LI3	–	E0	–	CV1
Model		Travel		Drive Screw		Coupling		Motor		Limit Switches		Linear Encoder		Covers

Product / Model

Product	**Model**
RB6	Standard Assembly
RB6P	Precision Assembly (lower angular errors) (Standard travels only)

Travel (Inches)

6, 12, 18, 24, 30, 36, 42, 48

Drive Screws (see Drive Screw Section)

5G	5.08mm (0.2 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
10MG	10mm (0.3937 Inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
20MG	20mm (0.7874 Inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
5GP	5.08mm (0.2 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
10MGP	10mm (0.3937 Inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
20MGP	20mm (0.7874 Inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)

Coupling — Type and Input Shaft *(see Coupling Section)*

BE4	Stainless Steel Bellows 0.25 inch shaft diameter
BE5	Stainless Steel Bellows 0.3125 inch shaft diameter
BE6	Stainless Steel Bellows 0.375 inch shaft diameter
OE4	Oldham 0.25 inch shaft diameter
OE5	Oldham 0.3125 inch shaft diameter
OE6	Oldham 0.375 inch shaft diameter
SE4	Stainless Steel Beam 0.25 inch shaft diameter
SE5	Stainless Steel Beam 0.3125 inch shaft diameter
SE6	Stainless Steel Beam 0.375 inch shaft diameter

Motors — Stepper (see Stepper Section on page G-1 and Motor Section)

P21n	Performance NEMA 23	(0.25 inch coupling)
P22n	Performance NEMA 23	(0.25 inch coupling)
S21n	Standard NEMA 23	(0.25 inch coupling)
S22n	Standard NEMA 23	(0.25 inch coupling)
S23n	Standard NEMA 23	(0.25 inch coupling)
S32n	Standard NEMA 34	(0.375 inch coupling)
S33n	Standard NEMA 34	(0.375 inch coupling)

n = T (Series), V (Parallel), N (Flying leads)

Motors — Servo *(see Servo Section on page H-1 and Motor Section)*

BN21	Performance NEMA 23	(0.25 inch coupling)
BN23	Performance NEMA 23	(0.25 inch coupling)
B22	Standard NEMA 23	(0.3125 inch coupling)
B23	Standard NEMA 23	(0.3125 inch coupling)
B23H	Standard NEMA 23	(0.3125 inch coupling)
BN31	Performance NEMA 34	(0.375 inch coupling)
BN32	Performance NEMA 34	(0.375 inch coupling)

Motors — Customer Supplied *(see Motor Section)*

X23n	Standard NEMA 23 Motor Mount
X34n	Standard NEMA 34 Motor Mount

n = X Customer Supplied and Mounted
n = C Customer Supplied and IDC Mounted

Limit Switches *(see Limit Switch Section)*

L0	No Limit Switch
LI2	2 Position Internal Hall Effect Limit Switch (2 over travel limit switches)
LI3	3 Position Internal Hall Effect Limit Switch (2 over travel limits & 1 home limit switch)

Encoders *(see Linear Encoder Section)*

E0	No Linear Encoder
EM1	1 Micron Resolution
EM2	2 Micron Resolution
EMR	Standard Motor Mounted Rotary Encoder
EMKR	1000 Line Encoder (where available)

Covers *(see Cover Section)*

CV0	No Covers
CV1	Neoprene Bellows Cover

Special Features *(see preceding page)*

(ordered as a separate line item)

Please contact IDC for non-standard applications or components.

Lead-times for complete positioning systems are determined by the lead-times of the individual components (precision tables, motors, gearmotors, drives and controls, etc.). Standard precision table lead-times apply to basic configurations and standard catalog options. Extended travels, environmental preparations, special components, special testing, special modifications and custom systems may require additional lead-time. Please contact IDC for further details.

High Precision—Versatile—Recirculating Linear Bearing
High Load Capacity & Throughput

Specifications

Typical Applications

- Pick and Place
- Inspection
- Assembly
- Deposition
- Contouring
- Laser Cutting
- Dispensing

General Specifications

Materials	Base and end plates — black anodized aluminum alloy (6061 and cast tool plate); Covers — clear anodized aluminum cast tool plate; Ballscrew and guideways — DIN 1.6523 and 1.3505 steel
Cross Section	152.4mm x 88.9mm (6 inches x 3.5 inches)
Travel Lengths (including limits and covers)	**Standard** — 152.4mm (6 inches), 304.8mm (12 inches), 457.2mm (18 inches) and 609.6mm (24 inches) **Extended** —762.0mm (30 inches), 914.4mm (36 inches), 1066.8mm (42 inches) and 1219.2mm (48 inches) (please refer to Travel Dependent Specifications)
Drive Screw	Preloaded precision ground ballscrew — JIS C3 & C5 (zero backlash) Nominal diameter 20mm (0.7874 inches)
Ballscrew Lead Options	5.08mm (0.2 inches), 10mm (0.3937 inches) or 20mm (0.7874 inches) (please refer to Travel Dependent Specifications for maximum speeds)
Bearings	Matched precision grade recirculating linear guideways Nominal coefficient of friction 0.008 Special high precision assembly option available for standard travels only
Couplings	Bellows, Oldham or Stainless Steel Beam (please refer to Coupling Section)
Motors	Stepper (standard, T or V options) or Servo; Nominal NEMA 23 or NEMA 34 frame size (please refer to Stepper Section G-1, Servo Section H-1 and Motor Section)
Limit Switches	Internal Hall Effect switches — non-adjustable; 3 position or 2 position — normally closed (please refer to Limit Switch Section)
Linear Encoder Resolution	1 micron (0.000039 inches) or 2 microns (0.000079 inches) (please refer to Linear Encoder Section)
Covers	Clear anodized aluminum plate (Nominal IP 30)
Environment	General industrial, clean room or vacuum (please refer to Environmental Section)
Normal Ambient Temperature	20°C ± 15°C (68°F ± 27°F) — special high or low temperature preparation also available
Normal Ambient Pressure	760 torr — 10^{-3} torr (standard preparation) — up to 10^{-7} torr (special preparation)
Normal Cleanliness	Class 1000 (standard preparation) — up to Class 100 (special preparation)
Audible Noise (max.)	70 dB at top speed (1m away from positioning system)
Maximum Input Torque	300 oz-in

Specifications

Global Specifications

Ballscrew Accuracy Tolerances[1,2] (maximum lead error tolerance)	**Travel of 600mm (24 inches) or less — JIS C3** 8 microns per 300mm — 6 microns per revolution 0.00032 inch per foot — 0.00024 inch per revolution **Travel of 600mm (24 inches) or less — JIS C1** 5 microns per 300mm — 4 microns per revolution 0.00020 inch per foot — 0.00016 inch per revolution **Travel greater than 600mm (24 inches) — JIS C5** 18 microns per 300mm — 8 microns per revolution 0.00072 inch per foot — 0.00032 inch per revolution
Unidirectional Repeatability (max.)[1,2] (without linear encoder)	**Travel 600mm (24 inches) or less** 3 microns (0.00012 inch) **Travel greater than 600mm (24 inches)** 4 microns (0.00016 inch)
Bi-directional Repeatability (max.)[1,2] (without linear encoder)	**Travel 600mm (24 inches) or less** 6 microns (0.00024 inch) **Travel Greater than 600mm (24 inches)** 8 microns (0.00032 inch)
Limit Switch Repeatability[2]	50 microns (0.002 inch) (please refer to Limit Switch Section)
Breakaway Torque (max.)[2]	0.141 Nm (20 oz-in)
Running Torque (max.)[2]	0.127 Nm (18 oz-in)
Nominal Acceleration (max.)[2]	2.0 g
Duty Cycle	100%
Normal Load Capacity (max.)[2,3]	±193 kg(f) (425 lbs.) (please refer to stiffness specifications)
Side Load Capacity (max.)[2,3]	±141 kg(f) (310 lbs.) (please refer to stiffness specifications)
Axial Load Capacity (max.)[2,3]	±47 kg(f) (110 lbs.) (please refer to stiffness specifications)
Roll Moment Capacity (max.)[2,3]	±133 Nm (96 ft-lb) (please refer to stiffness specifications)
Pitch Moment Capacity (max.)[2,3]	±106 Nm (77.5 ft-lb) (please refer to stiffness specifications)
Yaw Moment Capacity (max.)[2,3]	±71 Nm (52 ft-lb) (please refer to stiffness specifications)
Nominal Straightness[2,3] (horizontal straightness) Precision Option (standard travels only)	2 microns per 25mm (0.00008 inch per inch) Not to exceed travel dependent specifications 1 micron per 25mm (0.00004 inch per inch) Not to exceed travel dependent specifications
Nominal Flatness[2,3] (vertical straightness) Precision Option (standard travels only)	2 microns per 25mm (0.00008 inch per inch) Not to exceed travel dependent specifications 1 micron per 25mm (0.00004 inch per inch) Not to exceed travel dependent specifications
Normal Load Stiffness[2,3]	5.5 kg(f) per micron (300,000 lbs. per inch)
Side Load Stiffness[2,3]	4.0 kg(f) per micron (225,000 lbs. per inch)
Axial Load Stiffness[2,3]	0.65 kg(f) per micron (35,000 lbs. per inch)
Roll Moment Compliance[2,3]	0.75 arc-sec per Nm (1 arc-sec per ft-lb)
Pitch Moment Compliance[2,3]	0.75 arc-sec per Nm (1 arc-sec per ft-lb)
Yaw Moment Compliance[2,3]	1.5 arc-sec per Nm (2 arc-sec per ft-lb)
Precision X-Y Mounting Orthogonality (XYP)[2,3]	15 arc-sec
Moving Mass (carriage and bearing)	2.75 kg(f) (6 lbs.)

1 For applications requiring higher specification, interferometer testing, a higher accuracy ballscrew or a linear encoder may be necessary. Please refer to the Performance Verification Section and the Linear Encoder Section.

2 Please consult IDC if your application requirements exceed catalog specifications.

3 Based on the centerline of the table top.

All specifications are based on ISO 230-2 measurements of an unloaded, bolted down Precision Table with optimized motor tuning. These specifications were generated by measuring the peformance of a complete motion system that utilized IDC motors, drives and controls.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications

Travel Dependent Specifications

Standard Travels — Precision Assembly Option Available

	RC6-6	RC6-12	RC6-18	RC6-24
Travel — mm (inches)	152.4 (6)	304.8 (12)	457.2 (18)	609.6 (24)
Accuracy (error max.) — microns (inches)	12 (0.00048)	14 (0.00056)	16 (0.00064)	18 (0.00072)
Inertia — kgm^{2}x10^{-6} (oz-in-s^{2}x10^{-3})	61.7 (8.7)	84.4 (12.0)	107.1 (15.2)	129.8 (18.4)
Total Table Weight (without motors) — kg(f) (lbs.)	10.4 (23)	12.3 (27)	14.1 (31)	15.9 (35)
Top Speed — 5G screw — mm/s (inches/s)	322 (12.7)	322 (12.7)	322 (12.7)	214 (8.5)
Top Speed — 10MG screw — mm/s (inches/s)	635 (25.0)	635 (25.0)	635 (25.0)	422 (16.6)
Top Speed — 20MG screw — mm/s (inches/s)	1270 (50.0)	1270 (50.0)	1270 (50.0)	844 (33.3)
Roll Deviation (max.) ^{2,3} — arc-sec (precision)	16 (8)	18 (9)	20 (10)	24 (12)
Yaw Deviation (max.) ^{2,3} — arc-sec (precision)	16 (8)	18 (9)	20 (10)	24 (12)
Pitch Deviation (max.) ^{2,3} — arc-sec (precision)	16 (8)	18 (9)	20 (10)	24 (12)
Nominal Straightness (max.) ^{2,3} — microns (inches)	12 (0.00048)	16 (0.00064)	20 (0.00080)	24 (0.00096)
Precision Assembly Option	6 (0.00024)	8 (0.00032)	10 (0.00040)	12 (0.00048)
Nominal Flatness (max.) ^{2,3} — microns (inches)	12 (0.00048)	16 (0.00064)	20 (0.00080)	24 (0.00096)
Precision Assembly Option	6 (0.00024)	8 (0.00032)	10 (0.00040)	12 (0.00048)

Extended Travels — Precision Assembly Option Not Available

	RC6-30	RC6-36	RC6-42	RC6-48
Travel — mm (inches)	762.0 (30)	914.4 (36)	1066.8 (42)	1219.2 (48)
Accuracy (error max.) — microns (inches)	24 (0.00096)	28 (0.00112)	32 (0.00128)	36 (0.00144)
Inertia — kgm^{2}x10^{-6} (oz-in-s^{2}x10^{-3})	152.5 (21.6)	175.3 (24.8)	198.0 (28.0)	220.7 (31.3)
Total Table Weight (without motors) — kg(f) (lbs.)	17.7 (39)	19.5 (43)	21.3 (47)	23.1 (51)
Top Speed — 5G screw — mm/s (inches/s)	152 (6.0)	114 (4.5)	88 (3.5)	70 (2.8)
Top Speed — 10MG screw — mm/s (inches/s)	300 (11.8)	223 (8.8)	173 (6.8)	141 (5.5)
Top Speed — 20MG screw — mm/s (inches/s)	599 (23.6)	447 (17.6)	346 (13.6)	276 (10.8)
Roll Deviation (max.) ^{2,3} — arc-sec (precision)	40	45	50	55
Yaw Deviation (max.) ^{2,3} — arc-sec	40	45	50	55
Pitch Deviation (max.) ^{2,3} — arc-sec	40	45	50	55
Nominal Straightness (max.) ^{2,3} — microns (inches)	28 (0.00112)	32 90.00128)	36 (0.00144)	40 (0.00160)
Nominal Flatness (max.) ^{2,3} — microns (inches)	28 (0.00112)	32 90.00128)	36 (0.00144)	40 (0.00160)

Ballscrew Data

	Diameter mm (inches)	Efficiency	Direction	Duty Cycle	Contouring Thrust Load (max.) kg(f) (lbs.)
5G	20 (0.7874)	87%	Right Hand	100%	10.0 (22.0)
10MG	20 (0.7874)	90%	Right Hand	100%	7.0 (15.4)
20MG	20 (0.7874)	93%	Right Hand	100%	5.0 (11.0)

Life Calculation Constants (Dynamic Load Capacity)

(please refer to Bearing and Drivescrew Section)

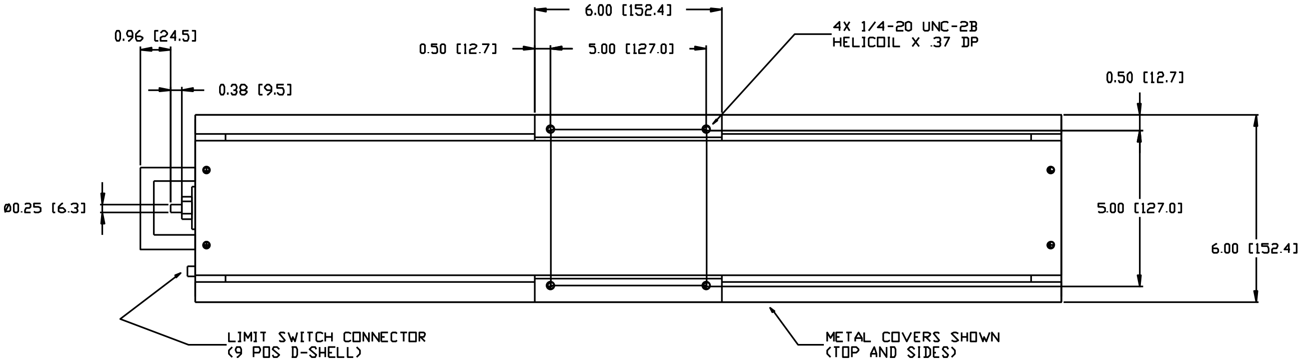
Bearings	640 kg(f)
5G Ballscrew	317 kg(f)
10MG Ballscrew	232 kg(f)
20MG Ballscrew	136 kg(f)

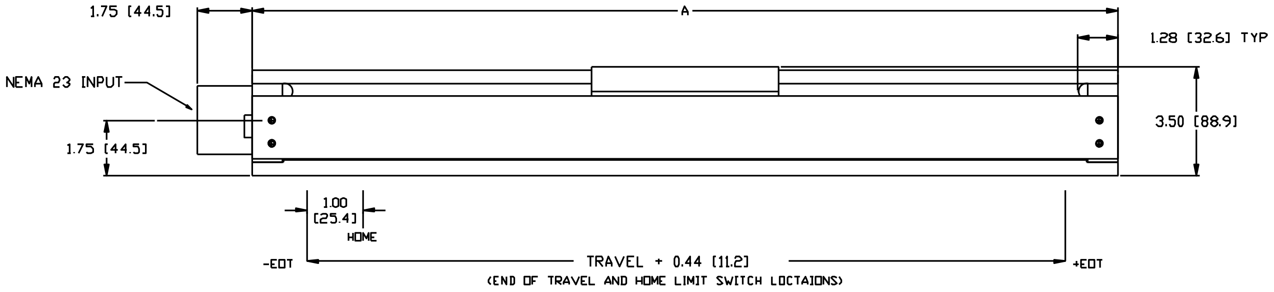
2 Please consult IDC if your application requirements exceed catalog specifications.

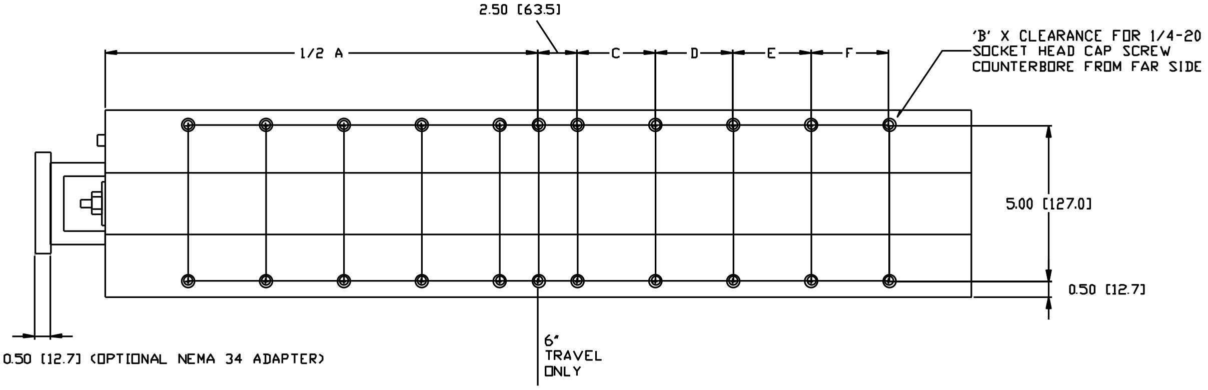
3 Based on the centerline of the table top.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications







Travel	A	B	C	D	E	F
6.00 (152.4)	15.81 (401.6)	10	2.50 (63.5)	—	—	—
12.00 (304.8)	21.81 (554.0)	8	5.00 (127.0)	—	—	—
18.00 (457.2)	27.81 (706.4)	12	5.00 (127.0)	5.00 (127.0)	—	—
24.00 (609.6)	33.81 (858.8)	12	5.00 (127.0)	5.00 (127.0)	—	—
30.00 (762.0)	39.79 (1010.7)	16	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	—
36.00 (914.4)	45.79 (1163.1)	16	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	—
42.00 (1066.8)	51.79 (1315.5)	20	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)
48.00 (1219.2)	57.79 (1467.9)	20	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)	5.00 (127.0)

Specifications

Basic Stepper Configuration

RC6-___-5G-OE4-P22T-LI3-E0-CV1

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 6, 12, 18, and 24
0.25 inch Oldham Coupling (OE4)

High Performance Step Motor (P22T)
3 Position Internal Limit Switches (LI3)
No Linear Encoder (E0)
Neoprene Bellows Covers (CV1)

(please refer to How to Order page for additional standard options)

Basic Servo Configuration

RC6-___-5G-BE4-BN23-LI3-E0-CV1

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 6, 12, 18, and 24
0.25 inch Bellows Coupling (BE4)

High Performance Servo Motor (BN23)
3 Position Internal Limit Switches (LI3)
No Linear Encoder (E0)
Neoprene Bellows Covers (CV1)

(please refer to How to Order page for additional standard options)

Make it an IDeal System

Include an IDC drive or control that is preconfigured for and tested with each Precision Table axis.
Stepper Choices: NextStep, SmartStep23, SmartStep, S6961 or S6962
Servo Choices: B8001, B8961 or B8962
(order as a separate line item)

Example:	RC6-18-5G-OE4-P22T-LI3-E0-CV1	2
	RC6 XYP	1
	SMART STEP23	2
	IDEAL SYSTEM	2

(please refer to the IDeal System Section for further details)

Standard Multi-Axis Configuration

Standard Precision X-Y Mounting (XYP) — 15 arc-sec Orthogonality — (dowel pinned assembly)

(ordered as a separate line item to assemble 2 separate tables)

Example:	RC6-12-5G-BE4-BN23-LI3-E0-CV1	2
	RC6 XYP	1

Carriage to Carriage Mounting (XYC) — 15 arc-sec Orthogonality — (permanent assembly)

(ordered as a separate line item to assemble 2 separate tables)

Example:	RC6-12-5G-BE4-BN23-LI3-E0-CV1	2
	RC6 XYC	1

(for applications requiring more complicated assemblies, please refer to the Multi-Axis Section)

Standard Environmental Preparations

All standard IDC precision tables are designed to operate in general industrial environments.
Standard environmental preparation for Class 100 Clean Room or 10^{-7} Vacuum environments is also available.
(ordered as a separate line item per axis)

Example:	RC6-18-5G-BE4-BN23-LI3-E0-CV1	2	Example:	RC6-6-5G-BE4-BN23-LI3-E0-CV0	2
	CLEAN 100	2		VACUUM	2
	RC6 XYP	1		RC6 XYP	1

(for applications requiring other non-standard environments, please refer to the Environmental Section)

Performance Verification and Testing

(ordered as separate line item per axis)

Example:	RC6-24-5G-OE4-P22T-LI3-E0-CV1	1
	TEST 1-1	1

(for applications requiring testing, please refer to the Performance Verification Section)

How To Order

Ordering Example

RC6	–	6	–	5G	–	OE4	–	P22T	–	LI3	–	E0	–	CV1
Model		Travel		Drive Screw		Coupling		Motor		Limit Switches		Linear Encoder		Covers

Product	Model
RC6	Standard Assembly
RC6P	Precision Assembly (lower angular errors) (Standard travels only)

Travel (Inches)

6, 12, 18, 24, 30, 36, 42, 48

Drive Screws *(see Drive Screw Section)*

5G	5.08mm (0.2 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
10MG	10mm (0.3937 Inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
20MG	20mm (0.7874 Inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
5GP	5.08mm (0.2 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
10MGP	10mm (0.3937 Inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)
20MGP	20mm (0.7874 Inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 24 inches)

Coupling — Type and Input Shaft *(see Coupling Section)*

BE4	Stainless Steel Bellows 0.25 inch shaft diameter
BE5	Stainless Steel Bellows 0.3125 inch shaft diameter
BE6	Stainless Steel Bellows 0.375 inch shaft diameter
OE4	Oldham 0.25 inch shaft diameter
OE5	Oldham 0.3125 inch shaft diameter
OE6	Oldham 0.375 inch shaft diameter
SE4	Stainless Steel Beam 0.25 inch shaft diameter
SE5	Stainless Steel Beam 0.3125 inch shaft diameter
SE6	Stainless Steel Beam 0.375 inch shaft diameter

Motors — Stepper (see Stepper Section on page G-1 and Motor Section)

P21n	Performance NEMA 23	(0.25 inch coupling)
P22n	Performance NEMA 23	(0.25 inch coupling)
S21n	Standard NEMA 23	(0.25 inch coupling)
S22n	Standard NEMA 23	(0.25 inch coupling)
S23n	Standard NEMA 23	(0.25 inch coupling)
S32n	Standard NEMA 34	(0.375 inch coupling)
S33n	Standard NEMA 34	(0.375 inch coupling)

n = T (Series), V (Parallel), N (Flying leads)

Motors — Servo *(see Servo Section on page H-1 and Motor Section)*

BN21	Performance NEMA 23	(0.25 inch coupling)
BN23	Performance NEMA 23	(0.25 inch coupling)
B22	Standard NEMA 23	(0.3125 inch coupling)
B23	Standard NEMA 23	(0.3125 inch coupling)
B23H	Standard NEMA 23	(0.3125 inch coupling)
BN31	Performance NEMA 34	(0.375 inch coupling)
BN32	Performance NEMA 34	(0.375 inch coupling)

Motors — Customer Supplied *(see Motor Section)*

X23n	Standard NEMA 23 Motor Mount
X34n	Standard NEMA 34 Motor Mount

n = X Customer Supplied and Mounted
n = C Customer Supplied and IDC Mounted

Limit Switches *(see Limit Switch Section)*

L0	No Limit Switch
LI2	2 Position Internal Hall Effect Limit Switch (2 over travel limit switches)
LI3	3 Position Internal Hall Effect Limit Switch (2 over travel limits & 1 home limit switch)

Encoders *(see Linear Encoder Section)*

E0	No Linear Encoder
EM1	1 Micron Resolution
EM2	2 Micron Resolution
EMR	Standard Motor Mounted Rotary Encoder
EMKR	1000 Line Encoder (where available)

Covers *(see Cover Section)*

CV0	No Covers
CV1	Aluminum Plate Covers

Special Features *(see preceding page)*

(ordered as a separate line item)

Please contact IDC for non-standard applications or components.

Lead-times for complete positioning systems are determined by the lead-times of the individual components (precision tables, motors, gearmotors, drives and controls, etc.). Standard precision table lead-times apply to basic configurations and standard catalog options. Extended travels, environmental preparations, special components, special testing, special modifications and custom systems may require additional lead-time. Please contact IDC for further details.

Specifications

Typical Applications

- Heavy Duty Pick and Place
- Heavy Work Piece Positioning
- Machining
- Contouring
- High Moment Loads
- Multi-Axis Systems (base)

General Specifications

Materials	Top and base — black anodized aluminum alloy (6061 and cast tool plate); Ballscrew and guideways — DIN 1.6523 and 1.3505 steel
Cross Section	203.2mm x 88.9mm (8 inches x 3.5 inches)
Travel Lengths	**Standard** — 152.4mm (6 inches), 304.8mm (12 inches), 457.2mm (18 inches), 609.6mm (24 inches) and 762.0mm (30 inches)
(including limits and covers)	**Extended** — 914.4mm (36 inches), 1066.8mm (42 inches), 1219.2mm (48 inches), 1371.6mm (54 inches) and 1524.0mm (60 inches) (please refer to Travel Dependent Specifications)
Drive Screw	Preloaded precision ground ballscrew — JIS C3 and JIS C5 (zero backlash) Nominal diameter 25mm (0.9843 inches)
Ballscrew Lead Options	5.08mm (0.2 inches), 10mm (0.3937 inches) or 25.4mm (1.0 inches) (please refer to Travel Dependent Specifications or maximum speeds)
Bearings	Matched precision grade recirculating linear guideways Nominal coefficient of friction 0.008 Special high precision assembly option available for standard travels only
Couplings	Bellows, Oldham or Stainless Steel Beam (please refer to Coupling Section)
Motors	Stepper (N, T or V options) or Servo; Nominal NEMA 34 frame size (please refer to Stepper Section G-1, Servo Section H-1 and Motor Section)
Limit Switches	Internal Hall Effect switches — non-adjustable 3 position or 2 position — normally closed (please refer to Limit Switch Section)
Linear Encoder Resolution	1 micron (0.000039 inches) or 2 microns (0.000079 inches) (please refer to Linear Encoder Section)
Covers	Neoprene Bellows (Nominal IP 53)
Environment	General industrial, clean room or vacuum (please refer to Environmental Section)
Normal Ambient Temperature	20°C ± 15°C (68°F ± 27°F) — special high or low temperature preparation also available
Normal Ambient Pressure	760 torr — 10^{-3} torr (standard preparation) — up to 10^{-7} torr (special preparation)
Normal Cleanliness	Class 1000 (standard preparation) — up to Class 100 (special preparation)
Audible Noise (max.)	70 dB at top speed (1m away from positioning system)
Maximum Input Torque	600 oz-in

Global Specifications

Ballscrew Accuracy Tolerances[1,2] (maximum lead error tolerance)	**Travel of 762.0mm (30 inches) or less — JIS C3** 8 microns per 300mm - 6 microns per revolution 0.00032 inches per foot - 0.00024 inches per revolution
	Travel of 762.0mm (30 inches) or less — JIS C1 5 microns per 300mm — 4 microns per revolution 0.00020 inch per foot — 0.00016 inch per revolution
	Travel greater then 762.0mm (30 inches) — JIS C5 18 microns per 300mm — 8 microns per revolution 0.00072 inches per foot — 0.00032 inches per revolution
Unidirectional Repeatability (max.)[1,2] (without linear encoder)	**Travel 762.0mm (30 inches) or less** 3 microns (0.00012 inches)
	Travel greater then 762.0mm (30 inches) 4 microns (0.00016 inches)
Bi-directional Repeatability (max.)[1,2] (without linear encoder)	**Travel 762.0mm (30 inches) or less** 6 microns (0.00024 inches)
	Travel greater then 762.0mm (30 inches) 8 microns (0.00032 inches)
Limit Switch Repeatability[2]	50 microns (0.002 inches) (please refer to Limit Switch Section)
Breakaway Torque (max.)[2]	0.247 Nm (35 oz-in)
Running Torque (max.)[2]	0.212 Nm (30 oz-in)
Nominal Acceleration (max.)[2]	2.0 g
Duty Cycle	100%
Normal Load Capacity (max.)[2,3]	±567 kg(f) (1,250 lbs.) (please refer to stiffness specifications)
Side Load Capacity (max.)[2,3]	±340 kg(f) (750 lbs.) (please refer to stiffness specifications)
Axial Load Capacity (max.)[2,3]	±82 kg(f) (180 lbs.) (please refer to stiffness specifications)
Roll Moment Capacity (max.)[2,3]	±534 Nm (394 ft-lb.) (please refer to compliance specifications)
Pitch Moment Capacity (max.)[2,3]	±446 Nm (329 ft-lb.) (please refer to compliance specifications)
Yaw Moment Capacity (max.)[2,3]	±149 Nm (110 ft-lb.) (please refer to compliance specifications)
Nominal Straightness[2,3] (horizontal straightness)	2 microns per 25mm (0.00008 inches per inch) Not to exceed travel dependent specifications
Precision Option — (standard travels only)	1 micron per 25mm (0.00004 inches per inch) Not to exceed travel dependent specifications
Nominal Flatness[2,3] (vertical straightness)	2 microns per 25mm (0.00008 inches per inch) Not to exceed travel dependent specifications
Precision Option — (standard travels only)	1 micron per 25mm (0.00004 inches per inch) Not to exceed travel dependent specifications
Normal Load Stiffness[2,3]	8.0 kg(f) per micron (450,000 lbs. per inch)
Side Load Stiffness[2,3]	7.3 kg(f) per micron (410,000 lbs. per inch)
Axial Load Stiffness[2,3]	0.9 kg(f) per micron (52,000 lbs. per inch)
Roll Moment Compliance[2,3]	0.22 arc-sec per Nm (0.3 arc-sec per ft-lb.)
Pitch Moment Compliance[2,3]	0.15 arc-sec per Nm (0.2 arc-sec per ft-lb.)
Yaw Moment Compliance[2,3]	0.85 arc-sec per Nm (2.5 arc-sec per ft-lb.)
Precision X-Y Mounting Orthogonality (XYP)[2,3]	15 arc-sec
Moving Mass (carriage and bearings)	4.1 kg(f) (9 lbs.)

[1] For applications requiring higher specification, interferometer testing, a higher accuracy ballscrew or a linear encoder may be necessary. Please refer to the Performance Verification Section and the Linear Encoder Section.

[2] Please consult IDC if your application requirements exceed catalog specifications.

[3] Based on the centerline of the table top.

All specifications are based on ISO 230-2 measurements of an unloaded, bolted down Precision Table with optimized motor tuning. These specifications were generated by measuring the peformance of a complete motion system that utilized IDC motors, drives and controls.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications

Table Diameter Dependent Specifications

Standard Travels — Precision Assembly Option Available

(Travel includes space for limit switches and bellows)

	RB8-6	RB8-12	RB8-18	RB8-24	RB8-30
Travel — mm (inches)	152.4 (6)	304.8 (12)	457.2 (18)	609.6 (24)	762.0 (30)
Accuracy (error max.) — microns (inches)	12 (0.00048)	14 (0.00056)	16 (0.00064)	18 (0.00072)	20 (0.00080)
Inertia — kgm^{2}x10^{-6} (oz-in-s^{2}x10^{-3})	223.2 (31.6)	275.7 (39.1)	328.3 (46.5)	380.8 (53.9)	433.3 (61.4)
Total Table Weight (without motors) — kg(f) (lbs.)	13.6 (30)	15.9 (35)	18.1 (40)	20.4 (45)	22.7 (50)
Top Speed — 5G screw — mm/s (inches/s)	261 (10.3)	261 (10.3)	244 (9.6)	178 (7.0)	135 (5.3)
Top Speed — 10MG screw — mm/s (inches/s)	513 (20.2)	513 (20.2)	481 (18.9)	349 (13.8)	265 (10.4)
Top Speed — 1G screw- mm/s (inches/s)	1303 (51.3)	1303 (51.3)	1222 (48.1)	887 (34.9)	674 (26.5)
Roll Deviation (max.)[2,3] — arc-sec (precision)	35 (22)	40 (24)	45 (26)	50 (28)	55 (30)
Yaw Deviation (max.)[2,3] — arc-sec (precision)	20 (10)	24 (12)	28 (14)	32 (16)	36 (18)
Pitch Deviation (max.)[2,3] — arc-sec (precision)	40 (22)	45 (24)	50 (26)	55 (28)	60 (30)
Nominal Straightness (max.)[2,3] — microns (inches)	12 (0.00048)	16 (0.00064)	20 (0.00080)	24 (0.00096)	28 (0.00112)
Precision Assembly Option	6 (0.00024)	8 (0.00032)	10 (0.00040)	12 (0.00048)	14 (0.00056)
Nominal Flatness (max.)[2,3] — microns (inches)	12 (0.00048)	16 (0.00064)	20 (0.00080)	24 (0.00096)	28 (0.00112)
Precision Assembly Option	6 (0.00024)	8 (0.00032)	10 (0.00040)	12 (0.00048)	14 (0.00056)

Extended Travels — Precision Assembly Option Not Available

(Travel includes space for limit switches and bellows)

	RB8-36	RB8-42	RB8-48	RB8-54	RB8-60
Travel — mm (inches)	914.4 (36)	1066.8 (42)	1219.2 (48)	1371.6 (54)	1524.0 (60)
Accuracy (error max.) — microns (inches)	28 (0.00112)	32 (0.00128)	36 (0.00144)	40 (0.00160)	44 (0.00176)
Inertia — kgm^{2}x10^{-6} (oz-in-s^{2}x10^{-3})	485.8 (68.8)	538.4 (76.2)	590.9 (83.7)	617.2 (87.4)	643.4 (91.1)
Total Table Weight (without motors) — kg(f) (lbs.)	24.9 (55)	27.2 (60)	29.5 (65)	31.8 (70)	34.0 (75)
Top Speed — 5G screw — mm/s (inches/s)	106 (4.2)	85 (3.4)	70 (2.8)	64 (2.5)	59 (2.3)
Top Speed — 10MG screw — mm/s (inches/s)	208 (8.2)	168 (6.6)	138 (5.4)	126 (5.0)	116 (4.6)
Top Speed — 1G screw- mm/s (inches/s)	529 (20.8)	426 (16.8)	350 (13.8)	320 (12.6)	293 (11.6)
Roll Deviation (max.)[2,3] — arc-sec	60	65	70	75	80
Yaw Deviation (max.)[2,3] — arc-sec	40	45	50	55	60
Pitch Deviation (max.)[2,3] — arc-sec	65	70	70	75	80
Nominal Straightness (max.)[2,3] — microns (inches)	32 (0.00128)	36 (0.00144)	40 (0.00160)	44 (0.00176)	48 (0.00192)
Nominal Flatness (max.)[2,3] — microns (inches)	32 (0.00128)	36 (0.00144)	40 (0.00160)	44 (0.00176)	48 (0.00192)

Drive Screw Data

	Diameter mm (inches)	Efficiency	Direction	Duty Cycle	Contouring Thrust Load (max.) kg(f) (lbs.)
5G	25 (0.9843)	87%	Right Hand	100%	16.0 (35.3)
10MG	25 (0.9843)	90%	Right Hand	100%	11.0 (24.3)
1G	25 (0.9843)	93%	Right Hand	100%	7.0 (15.4)

Life Calculation Constants (Dynamic Load Capacity)

(please refer to Bearing and Drivescrew Section)

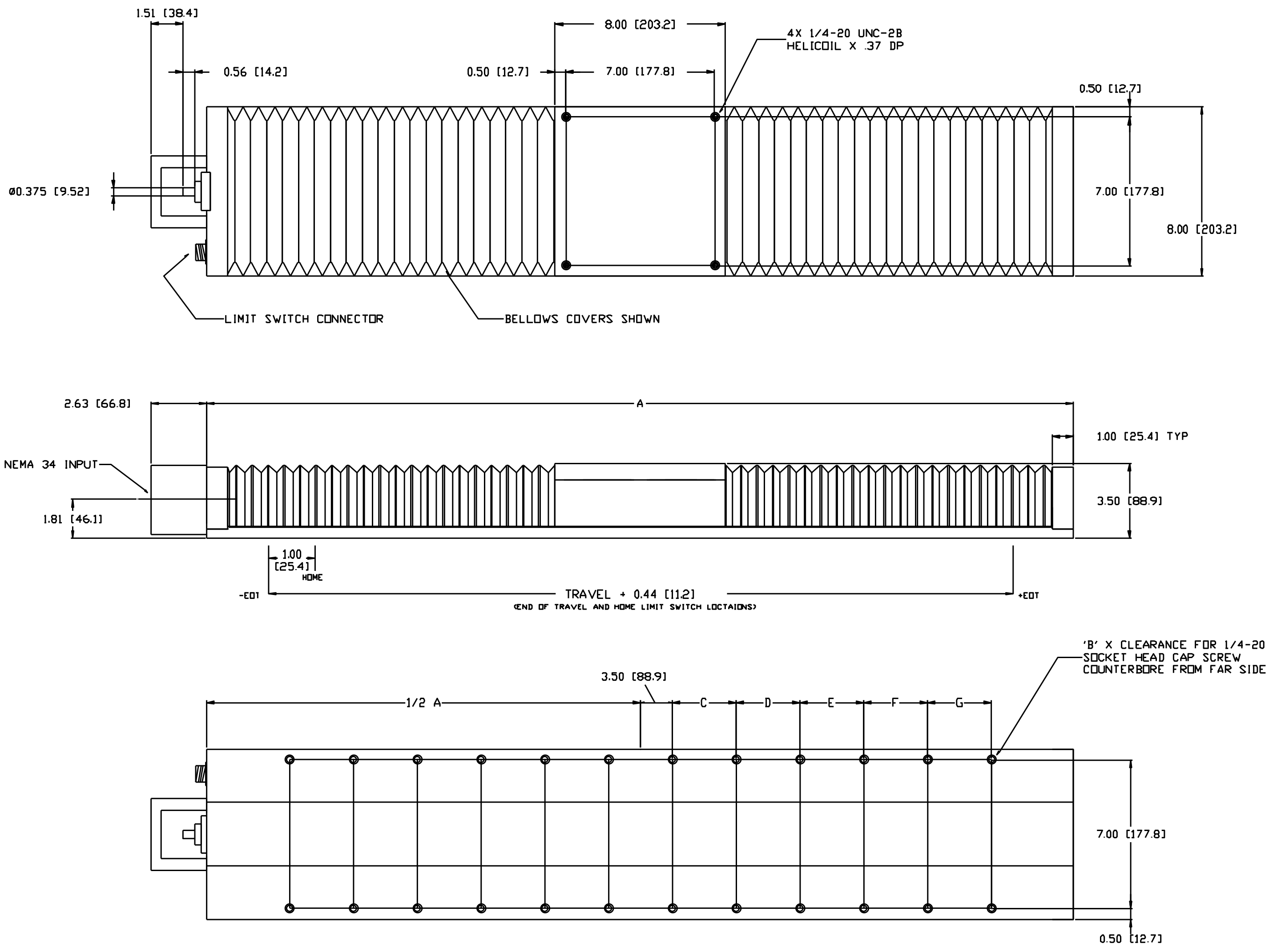
Bearings	1550 kg(f)
5G Ballscrew	467 kg(f)
10MG Ballscrew	373 kg(f)
1G Ballscrew	283 kg(f)

[2] Please consult IDC if your application requirements exceed catalog specifications.

[3] Based on the centerline of the table top.

Note: IDC accuracy measurements are based on a stable 20°C environment. Thermal variations can affect application results significantly.

Specifications



Travel	A	B	C	D	E	F	G
6.00 (152.4)	20.66 (524.8)	4.00	—	—	—	—	—
12.00 (304.8)	27.36 (694.9)	8.00	7.00 (177.8)	—	—	—	—
18.00 (457.2)	34.07 (865.4)	8.00	7.00 (177.8)	—	—	—	—
24.00 (609.6)	40.77 (1035.6)	12.00	7.00 (177.8)	7.00 (177.8)	—	—	—
30.00 (762.0)	47.48 (1206.0)	12.00	7.00 (177.8)	7.00 (177.8)	—	—	—
36.00 (914.4)	54.35 (1380.5)	16.00	7.00 (177.8)	7.00 (177.8)	7.00 (177.8)	—	
42.00 (1066.8)	61.15 (1553.2)	16.00	7.00 (177.8)	7.00 (177.8)	7.00 (177.8)	—	—
48.00 (1219.2)	67.93 (1725.4)	20.00	7.00 (177.8)	7.00 (177.8)	7.00 (177.8)	7.00 (177.8)	—
54.00 (1371.6)	74.65 (1896.1)	20.00	7.00 (177.8)	7.00 (177.8)	7.00 (177.8)	7.00 (177.8)	—
60.00 (1524.0)	81.39 (2067.3)	24.00	7.00 (177.8)	7.00 (177.8)	7.00 (177.8)	7.00 (177.8)	7.00 (177.8)

Specifications

Basic Stepper Configuration

RB8-___-5G-OE8-P32V-LI3-E0-CV1

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 6, 12, 18, 24, and 30
0.5 inch Oldham Coupling (OE8)

High Performance Step Motor (P32V)
3 Position Internal Limit Switches (LI3)
No Linear Encoder (E0)
Neoprene Bellows Covers (CV1)

(please refer to How to Order page for additional standard options)

Basic Servo Configuration

RB8-___-5G-BE6-BN32-LI3-E0-CV1

Standard Precision Assembly
Precision Ground Ballscrew (5G)
Travel (inches) 6, 12, 18, 24, and 30
0.375 inch Bellows Coupling (BE6)

High Performance Servo Motor (BN32)
3 Position Internal Limit Switches (LI3)
No Linear Encoder (E0)
Neoprene Bellows Covers (CV1)

(please refer to How to Order page for additional standard options)

Make it an IDeal System

Include an IDC drive or control that is preconfigured for and tested with each Precision Table axis.
Stepper Choices: NextStep, SmartStep, S6961 or S6962
Servo Choices: B8001, B8961 or B8962
(order as a separate line item)

Example:	RB8-18-5G-OE8-P32T-LI3-E0-CV1	2
	RB8 XYP	1
	SMART STEP	2
	IDEAL SYSTEM	2

(please refer to the IDeal System Section for further details)

Standard Multi-Axis Configuration

Standard Precision X-Y Mounting (XYP) — 15 arc-sec Orthogonality — (dowel pinned assembly)

(ordered as a separate line item to assemble 2 separate tables)

Example:	RB8-24-5G-BE6-BN32-LI3-E0-CV1	2
	RB8 XYP	1

(for applications requiring more complicated assemblies than XYP, please refer to the Multi-Axis Section)

Standard Environmental Preparations

All standard IDC precision tables are designed to operate in general industrial environments.
Standard environmental preparation for Class 100 Clean Room or 10^{-7} Vacuum environments is also available.
(ordered as a separate line item per axis)

Example:	RB8-18-5G-OE8-P32V-LI3-E0-CV0	2	Example:	RB8-12-5G-BE6-BN32-LI3-E0-CV0	2
	CLEAN 100	2		VACUUM	2
	RB8 XYP	1		RB8 XYP	1

(for applications requiring other non-standard environments, please refer to the Environmental Section)

Performance Verification and Testing

(ordered as separate line item per axis)

Example:	RB8-30-5G-OE8-P32V-LI3-E0-CV1	1
	TEST 1-1	1

(for applications requiring testing, please refer to the Performance Verification Section)

More Info?

More information, including a copy of the Owner's Manual is available by visiting IDC's web site or by contacting IDC.

How To Order

Ordering Example

RB8	–	24	–	5G	–	OE8	–	P32V	–	LI3	–	E0	–	CV1
Model		Travel		Drive Screw		Coupling		Motor		Limit Switches		Linear Encoder		Covers

Product Model

RB8	Standard Assembly
RB8P	Precision Assembly (lower angular errors) (Standard travels only)

Travel (inches)

6, 12, 18, 24, 30, 36, 42, 48, 54, 60

Drive Screws *(see Drive Screw Section)*

5G	5.08mm (0.2 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 30 inches)
10MG	10mm (0.3937 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 30 inches)
1G	25.4mm (1.0 inch) JIS C3 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 30 inches)
5GP	5.08mm (0.2 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 30 inches)
10MGP	10mm (0.3937 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 30 inches)
1GP	25.4mm (1.0 inch) JIS C1 Precision Ground Ballscrew Preloaded — Zero Backlash (JIS C5 for travel over 30 inches)

Coupling — Type and Input Shaft *(see Coupling Section)*

BE6	Stainless Steel Bellows 0.375 inch shaft diameter
BE8	Stainless Steel Bellows 0.5 inch shaft diameter
BE10	Stainless Steel Bellows 0.625 inch shaft diameter
OE6	Oldham 0.375 inch shaft diameter
OE8	Oldham 0.5 inch shaft diameter
OE10	Oldham 0.625 inch shaft diameter
SE6	Stainless Steel Beam 0.375 inch shaft diameter
SE8	Stainless Steel Beam 0.5 inch shaft diameter
SE10	Stainless Steel Beam 0.625 inch shaft diameter

Motors - Stepper *(see Stepper Section on page G-1 and Motor Section)*

P31n	Performance NEMA 34	(0.5 inch coupling)
P32n	Performance NEMA 34	(0.5 inch coupling)
P33n	Performance NEMA 34	(0.625 inch coupling)
S32n	Standard NEMA 34	(0.375 inch coupling)
S33n	Standard NEMA 34	(0.375 inch coupling)

n = T (Series), V (Parallel), N (Flying leads)

Motors - Servo *(see Servo Section on page H-1 and Motor Section)*

BN31	Performance NEMA 34	(0.375 inch coupling)
BN32	Performance NEMA 34	(0.375 inch coupling)
B31	Standard NEMA 34	(0.5 inch coupling)
B32	Standard NEMA 34	(0.5 inch coupling)
B33	Standard NEMA 34	(0.5 inch coupling)

Motors - Customer Supplied *(see Motor Section)*

X34n Standard NEMA 34 Motor Mount

n = X Customer Supplied and Mounted
n = C Customer Supplied and IDC Mounted

Limit Switches *(see Limit Switch Section)*

L0	No Limit Switches
LI2	2 Position Internal Hall Effect Limit Switch (2 over travel limit switches)
LI3	3 Position Internal Hall Effect Limit Switch (2 over travel limits & 1 home limit switch)

Encoders *(see Linear Encoder Section)*

E0	No Linear Encoder
EM1	1 Micron Resolution
EM2	2 Micron Resolution
EMR	Standard Motor Mounted Rotary Encoder
EMKR	1000 Line Encoder (where available)

Covers *(see Cover Section)*

CV0	No Covers
CV1	Neoprene Bellows Cover

Special Features *(see preceding page)*

(ordered as a separate line item)

Please contact IDC for non-standard applications or components.

Lead-times for complete positioning systems are determined by the lead-times of the individual components (precision tables, motors, gearmotors, drives and controls, etc.). Standard precision table lead-times apply to basic configurations and standard catalog options. Extended travels, environmental preparations, special components, special testing, special modifications and custom systems may require additional lead-time. Please contact IDC for further details.