ADC's 2012 December brief…

We would like to take this opportunity to thank you for all of your support in 2012. During the holiday season more than ever, our thoughts turn gratefully to those who have made our progress possible; and in this spirit we say, simply but sincerely: Thank You and Best Wishes for the Holiday Season and a very Happy New Year!!!

In 2012 we made many changes within our company, added several new capabilities, implemented new quality control procedures and have delivered some of the finest engineering products.

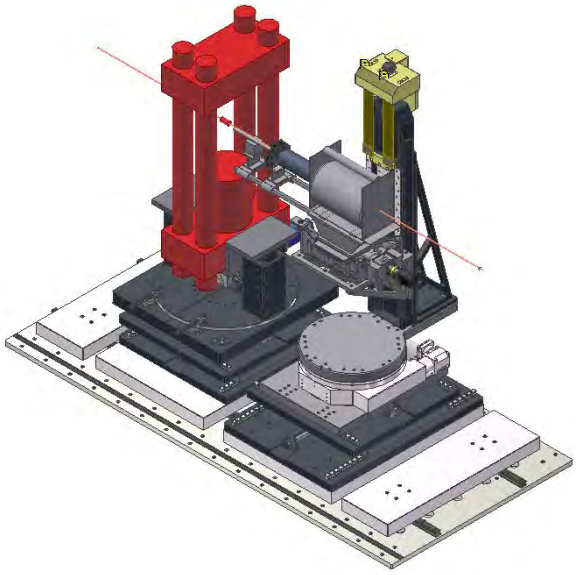
The end of 2012 is also a milestone for ADC. We are celebrating 16 years of delivering some of the most complex engineering systems to world class research and scientific facilities around the world.

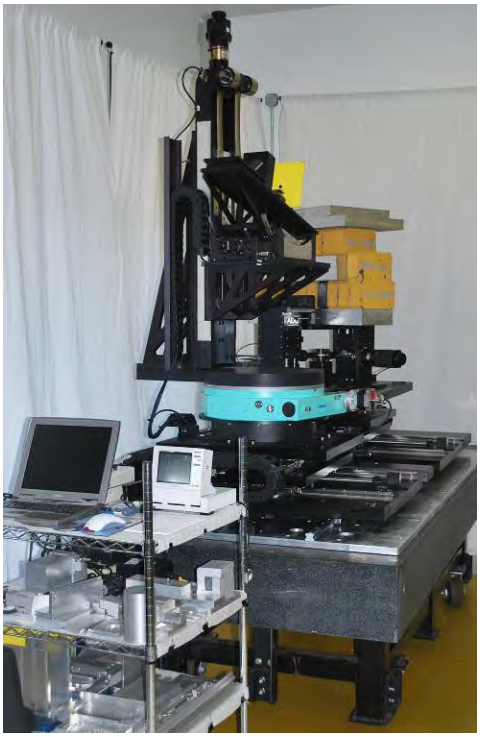
In 2012 ADC delivered hundreds of our standard products such as Slits, Ion Chambers, and standard high precision motion stages to facilities around the world. The following is a short description of custom projects delivered as well as on-going projects at ADC.

ADC USA, Inc., 126 Ridge Road, P.O. Box 187, Lansing, NY 14882
Tel: 607 533-3531, Fax: 607 533-3618, Web: www.adc9001.com, E-mail: adc@adc9001.com

Projects Delivered to Customers in 2012…

1. Eleven Axis Custom Design Motion for a Press and a Detector System (APS - USA)





A system was designed for University of Chicago (Advanced Photon Source – USA) which allows for the positioning of a large press that is aligned with the beam and a detector that is located downstream. Since the press and detector need to move independently, two sub-systems were designed. One sub-system controls the motion of the 600lb press. The second sub-system supports a detector assembly and provides motion in several directions. Both sub-systems share a set of guide rails which are mounted to a large base plate. This plate is designed to be grouted to the hutch floor, providing a permanent and stable base for the entire system. The sub-systems can be manually moved back and forth on the guide rails and secured using manual rail clamps. Features include:

- Grouted Floor Plate
- µ Positioning
- 11 Axis; Tilt, Rotation, Linear Motions
- Large load capability

There are four degrees of freedom for the press sub-system. Vertical motion is provided by two DJ400-100 Crossed Roller Jacks. Custom linear slides provide motion transverse to the beam and in the beam direction. A high-load-capacity manual rotation stage allows for rough positioning of the press and sample alignment. An attachment for motorized rotation provides fine adjustment of the manual stage.

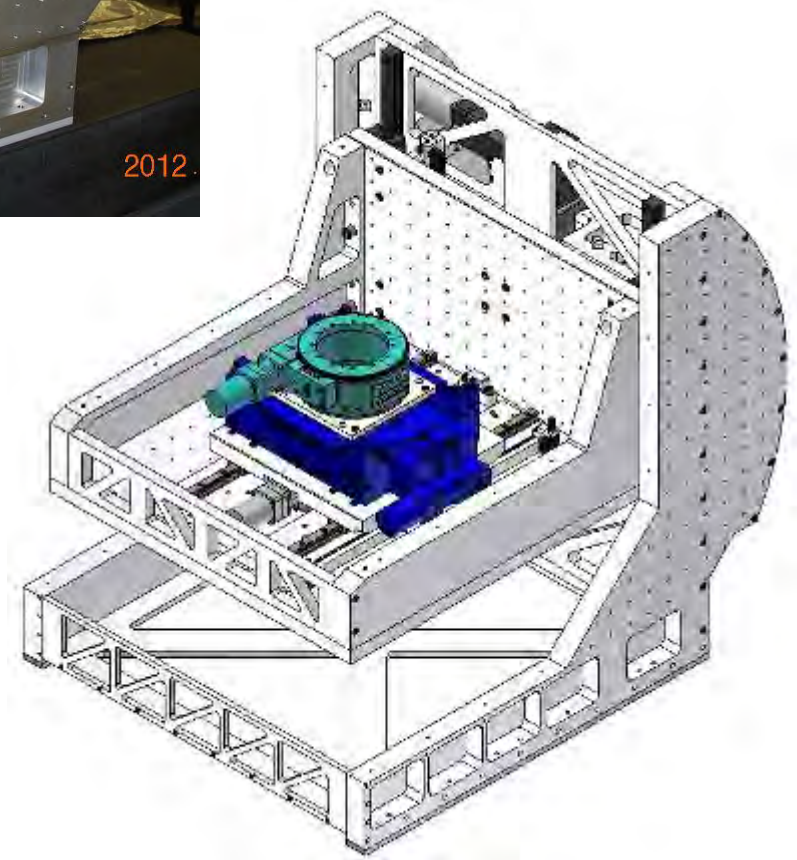
For detailed project information please visit:
http://www.adc9001.com/products/view/430

2. Colorado Gimbal System for MOBI High Vacuum (Univ. of Colorado – USA)

A high precision motion system is required to operate in the MOBI Vacuum Chamber at a High Vacuum level. The motion system consists of: 1 Custom High Precision Linear Slide used for vertical travel; 1 Custom High Precision Linear Slide used for horizontal travel; 1 High Precision Rotation stage that will provide a yaw motion; and 1 High Precision Tilt stage that will provide a pitch motion. Key Specifications: Vacuum 1 x 10 -8 TORR; Vertical Slide 362 mm; Horizontal Slide 368 mm; Tilt ±18; Rotation Full 360º.

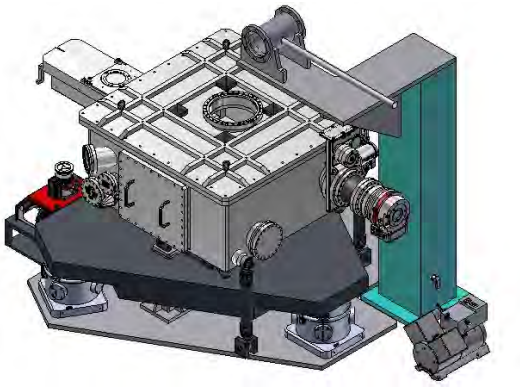
PC Control Architecture:

- LabView Software
- Galil DMC-40x0 motion controller
- Dell PC
- Running 2-phase stepper motors



For more detailed project information please visit:
http://www.adc9001.com/products/view/427

3. Berkeley (ALS) State-of-the-art High-Resolution Extreme-Ultraviolet-Light (EUV) Microscope



This system contains a state-of-the-art high-resolution extreme-ultraviolet-light (EUV) microscope for imaging of EUV photomasks. These photomasks are critical components in photolithography—the process used to mass-produce semiconductor electronic devices.

Major components of the system include: a large vacuum chamber to house the experimental area; active vibration control system; 3 axis in-vacuum motion stages; and an automated load-lock for inserting the EUV photomasks.

The system was designed for nm-scale stability, light exclusion (internal darkness), and ease of maintenance. It operates near ultra-high vacuum (UHV) conditions, requiring a base pressure of 1e-7 Torr, and therefore has a high degree of cleanliness and the exclusive use of compatible materials and components that do not outgas. Owing to the high resolution of the microscope (down to 30-nm), the system was designed for nm-scale relative stability of the critical mask and (zone plate) lens over exposure time periods up to one minute. It was designed so internal components do not radiate light into the chamber, or "glow" from internal heat generation.

A mask-transfer system enables masks to be loaded and unloaded from the system chamber. The mask transfer system gently, cleanly, and safely handles the mask loading, installation, unloading and removal.

The Mask XYZ stage is the heart of the system and the primary navigation tool in the system. Specifications for the XYZ stages are as follows:

Table 1: Mask stage specifications

Axis	Travel (mm)	Resolution (nm)	Repeatability (µm)
X	250.00	< 100	±0.50
Y	250.00	< 100	±0.50
Z	5.00	< 50	±0.50

The system was designed for 5-nm stability over 30 seconds between the mask and zone plate, during measurement. This is accomplished with high resolution encoders for each axis and the active vibration control system that isolates the XYZ stages.

- Active Vibration
- 50-100 Nano Positioning
- Acoustic Enclosure
- Grouted Floor Plate

For detailed project information please visit:
http://www.adc9001.com/products/view/429

4. Four Turn-Key "Three Degrees of Freedom" Custom High Precision Motorized Custom Optical Tables for the Air Force Research Laboratory (AFRL - USA)

Hardware Description:

3-Axis Optical Table built for AFRL-Jacobs Tech was designed for use in PIV experiments. The Newport optical breadboard provides a rigid surface for mounting and supporting measurement equipment. Utility Jacks each have a load capacity of 25kN. Each linear slide is actuated by precision ground ballscrews and supported by caged ball linear guide rails.

Software Description:

ADC's 3 axis optical tables can be controlled in either of two modes. The first mode uses a 3 axis analogue joystick interfaced directly to a Galil DMC-4133 controller. In this mode a personal computer is not required. The second mode uses a custom graphical user interface control written in LabVIEW for the project. This software is compatible with Windows XP through Windows 7.

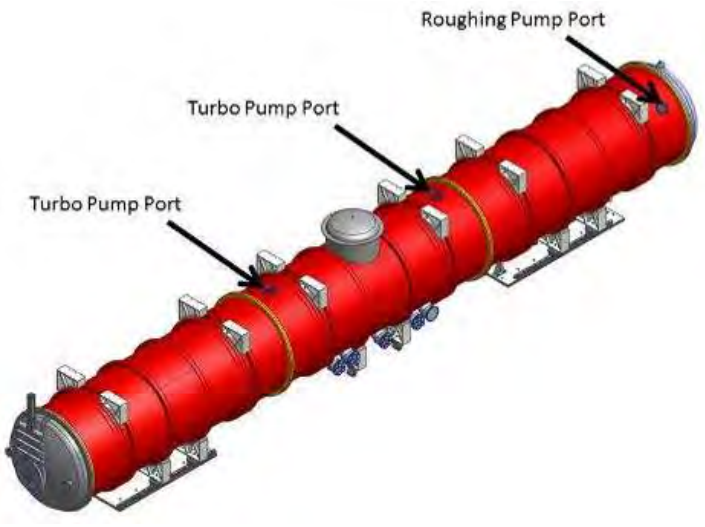
The joystick connects to the power supply/controller box using a standard DB-9 cable. The controller provides 0V and +5V signals and reads 3 analog responses from the joystick. These are read by opto-isolated 12 bit analog to digital converters and are scaled to produce commanded velocities for the three axes. The maximum velocity and acceleration can be programmed into the controller. Non-linear responses can be programmed if there is a need for finer control at low speed while allowing a high maximum speed to be available.

ADC provides a custom, stand-alone graphical user interface written in LabVIEW. The computer is connected to the controller box using a standard Ethernet cable. The GUI gives easy, intuitive control over each motor. Motions can be specified in microsteps or millimeters, with a smallest motion determined by motor resolution and gearing. Where encoders are included in a table, both open loop and closed loop motion are available. Motor parameters, such as run current, hold current, velocity and acceleration can all be set in this software.

For more information on our optical tables please visit:
http://www.adc9001.com/products/show_list/id/105

5. ANSTO (Australia): Time-of-Flight Small-Angle Neutron Scattering (SANS) Instrument

Bilby Detector vessel will be delivered for the new Time-of-Flight Small-Angle Neutron Scattering (SANS) instrument for the Australian Nuclear Sciences and Technology Organization (ANSTO) In Australia. SANS is a powerful technique for looking at structures of objects on the nanoscale (1-10nm), like polymer molecules, defect structures in metals and ceramics. Features include:



- High Precision Movement of 22 Ton System
- µ Positioning of Detector Platform over 22 m Travel
- Meeting Strict ASME and International Codes

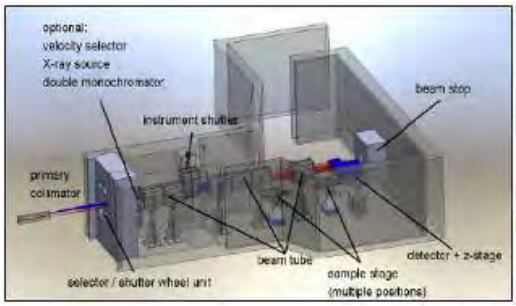
Key Specifications:

1)	Vacuum	7.5 x 10 -5 TORR, Leak Rate = 1 x 10-7 mbar-l/sec
2)	Vessel Diameter	2300 mm
3)	Internal Diameter Tolerance	0 to + 10 mm
4)	Vessel Length	65.7 feet (20020 mm) with the ends closed
5)	Vessel Straightness	Front to Back, +/- 10 mm
10)	Internal Carriage Capacity	1000 kg
11)	Quick release latches	Top and Rear Hatch
12)	Internal Movement	~ 60 Feet (15,240 mm)
13)	Internal Drive	Rack and Pinion
14)	Internal Velocity	4 m/min
15)	External Movement	59 inches (1500 m)
16)	External Drive	Ball Screw

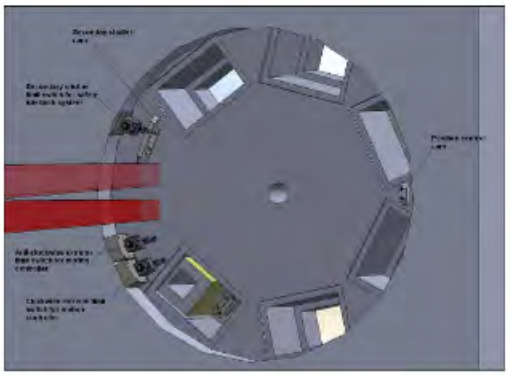
For detailed project information please visit:
http://www.adc9001.com/products/view/461

6. Selector Wheel System for DINGO Instrument (ANSTO – Australia)

This system is for the Bragg Institute, a division of ANSTO, to provide a selector wheel shutter unit for their Radiography Instrument, which is in the final stages and will soon be shipped to ANSTO.



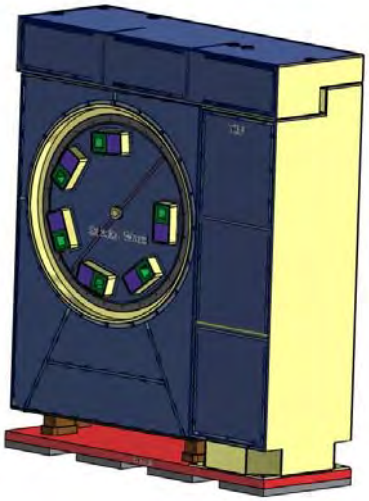
This new state-of-the-art instrument is to supports the area of neutron imaging research (neutron radiography/ tomography). It provides university, government and industry-based users of the new ANSTO research reactor OPAL a new world-class powerful tool for nondestructive real space testing and evaluation, with properties complementary to x-rays and synchrotron methods. The instrument covers a large area of scientific research from medical applications, biology and environmental science, geology and engineering science as well industrial application, which are key areas for future technology and industrial developments in Australia.



The selector wheel shutter unit combines two different functions in one item. The first function is to work as an instrument shutter and the second one is to work as a selector wheel.

The selector wheel assembly component as suggested in its name provides selective aperture options for high resolution or phase contrast imaging and separate the two beams coming from the in-pile collimator. One beam is blocked and the other passes the selector wheel insert to be used for an imaging experiment. A positioning accuracy of 0.01° step width is essential.

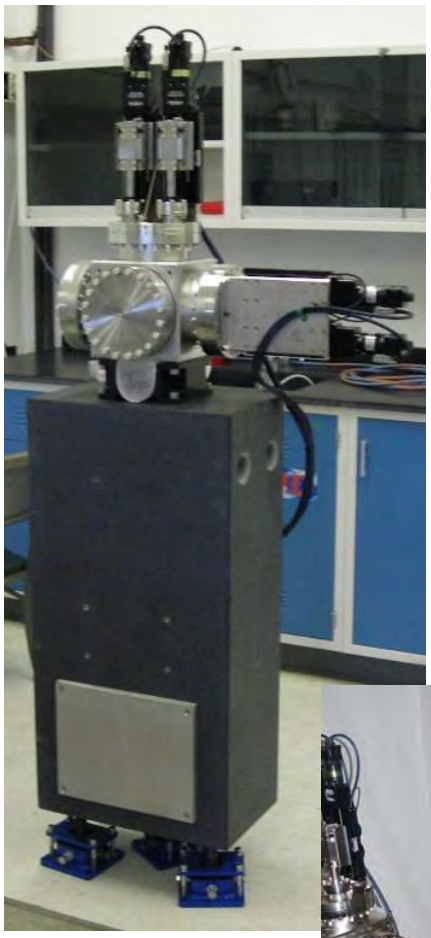
The selector wheel was designed with a stepped housing to mate with the inserts and prevent direct shine from the beam.



For detailed project information, please visit:
http://www.adc9001.com/products/view/462

7. Design and Build Beamline Components for Shanghai Synchrotron Radiation Facility (SSRF) NFPS Project (China)

ADC is to develop a number of beamline components for the Micro Crystallography beamline, High Flux beamline, Crystallography beamline and finally BioSAXS beamline. SSRF is an intermediate energy third generation light source with energy of 3.5 GeV, which produces a high intensity source of infrared, visible, ultraviolet and x-ray radiation.



For detailed information about our slits please visit:
http://www.adc9001.com/SLITS

8. 4 Sets of Ultra-High Precision Slits for Diamond Light Source (UK)

The Slits consist of vertical and horizontal slit mechanisms, a vacuum vessel which houses them, stepper motors, limit switches and electrical connections for beam monitoring system and a stand for the vacuum chamber to attach to. Each of the four blades are individually controlled and motorized.

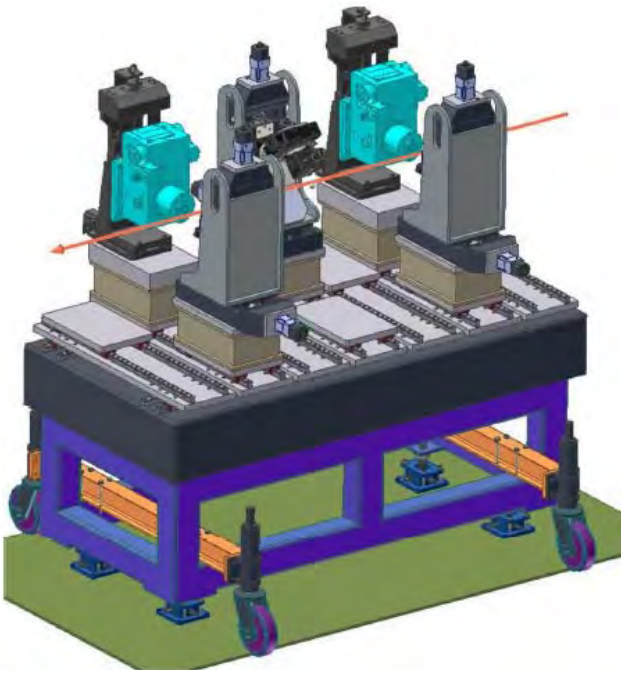
Cross-roller bearing technology is used for exceptional straightness of travel. Standard micro stepped stepper motors that are used could be controlled with a wide array of controllers/drivers available on the market. The design incorporates limit switches and comes with linear encoders.

All blades can travel past each other without interference (Overlapping/Zero Beam). The accuracy of the linear encoder is better than 0.5 micron. An easily visible linear scale for each blade is attached to its translation system to provide an alternate way of reading the blade position. Limit switches and hard stops prevent damage by over-travel. The four blades are electrically conductive and insulated from the vacuum vessel. Each blade is connected to a feedthrough with a standard BNC connector. Two fiducial marks are provided per slit unit as well as height references on the vacuum chamber. All UHV sections are vacuum tested to better than $5x10^{-10}$ torr and have a leak rate of less than $2x10^{-10}$ mbar $1^{-1}s^{-1}$. Kinematic mounts on the base offer fine adjustment when lining up the slit to the beamline.

For detailed information about our slits please visit:
http://www.adc9001.com/SLITS

9. Ultra-High Energy Resolution Monochromator/ Analyzer meV Prototype System Brookhaven (NSLS II - USA)

The NSLS II Inelastic X-ray Scattering (IXS) project beamline research and development effort is to investigate and develop the optical scheme for an Ultra-high energy resolution monochromator/analyzer of the CDDW-CDDW type. Each monochromator and analyzer consists of one collimation and wavelength ("C/W") selection silicon crystal and two dispersion ("D") silicon crystals. The configuration also includes a collimating mirror to collect photons from the sample to be directed into the analyzer.



For more information please go to:
http://www.adc9001.com/BNL-meV-Prototype-System

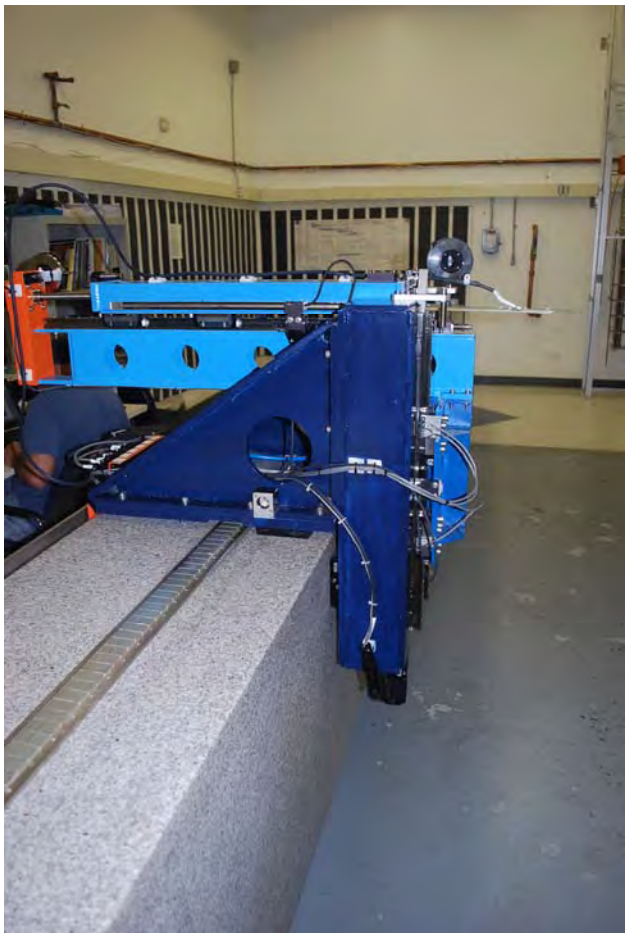
10. Magnetic Field Measurement System was designed and installed for DANFYSIK in Denmark

ADC has been building magnetic measurement systems for many years. We have delivered benches of various designs to MaxLab, SSRF, PAL, NSLS II, and Danfysik.

Specifications: Base System (5 m)

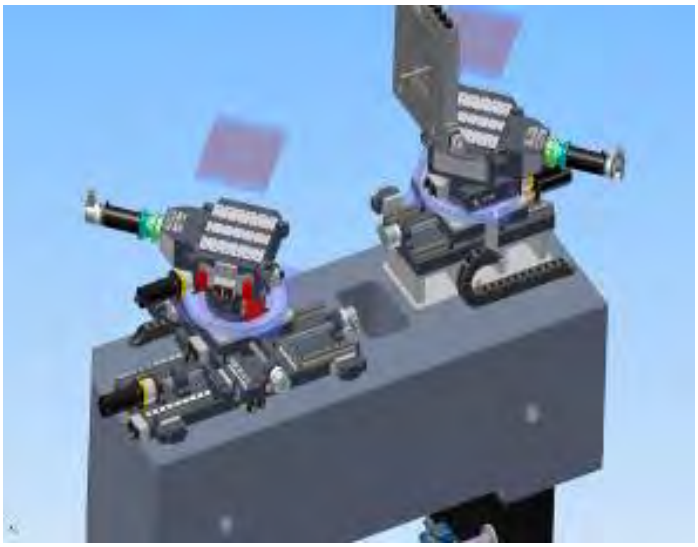
Granite:	Dimensions:	680 mm Wide x 800 mm High x 6 m Long	
	Flatness:	25 um	
	Straightness:	25 um	
	Material:	Low Magnetite Granite	
Travel:	X – 300 mm,	Resolution - .1 um,	Accuracy - +/- 1 um
	Y – 300 mm,	Resolution - .1 um,	Accuracy - +/- 1 um
	Z – 5000 mm,	Resolution - .1 um,	Accuracy - +/- .5 ppm

Nominal Beam Height: 1200 mm (please specify)



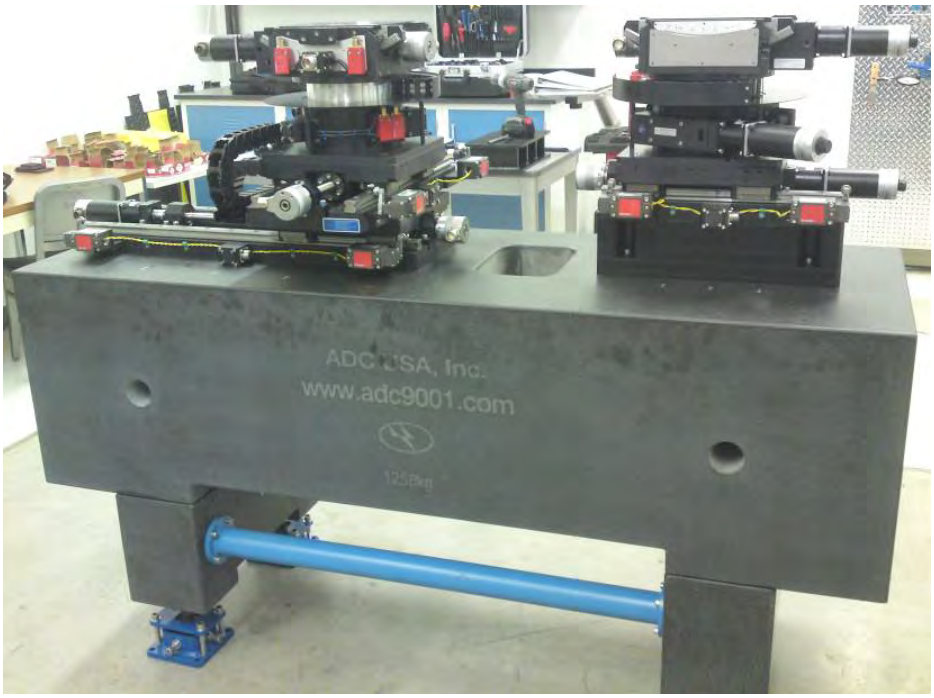
For more information please go to:
http://www.adc9001.com/Magnetic-Field-Measurement-Systems

11. Ultra-Small-Angle Neutron Scattering (USANS) Monochromator Instrument (Australia)



Ultra-small-angle neutron scattering (USANS) is a method for studying structures in the 100 nm to 10 μm range by diffraction. USANS uses a neutron beam with an extremely sharp angular profile which can be obtained by diffraction from a perfect crystal ("Bonse-Hart" technique).

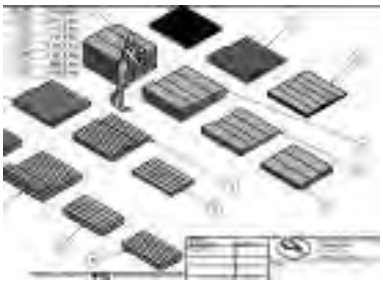
For this application a mix of ADC standard products and new customized stages have been used. For the placement of the premonochromator a rotation and tilt stage is used. For placement of channel cut monochromator crystal (CC1) positioning; a linear stage for the x axis, rotation stage is used around the z axis, and tilt stage is used in respect to the x and y axis'. For the channel-cut analyzer crystal (CC2) position; two linear stages have been used for x and y axis', a rotation stage is used around z axis, and again a tilt stage is used in respect to the x and y axis'. A 500mm linear stage is used along the x axis for positioning the main detector. Also included with this system are two slit systems for focusing the neutron beam.

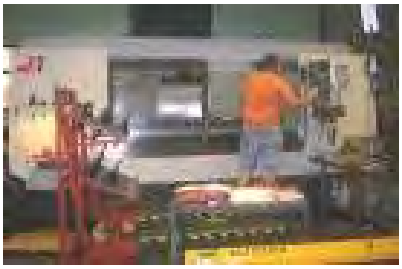


For more information please go to:
http://www.adc9001.com/ANSTO-Motion-Control-Stages-Kookaburra

12. Transport Magnet for Jefferson Laboratory (JLAB-USA)

ADC fabricated a large order of magnet material for Jefferson Laboratory's latest upgrade. All the magnet materials had to come from the same heat from a mill supplier, material had to be heat treated with very tight tolerances, magnet material then rough cut, strict material handling procedures were implemented to not use magnetic lifting devices (not to magnetize the material), parts were then machined using large machining centers to achieve the tight machining tolerances for large pieces, parts were then painted, and delivered for assembly at JLab.







For more detailed project information please go to:
http://www.adc9001.com/H-Steel-for-Jefferson-Laboratories-Magnet-Upgrades

13. NSLS-II Insertion Device Integrated Field Measurement System for BNL (USA)

The Integrated Field Measurement System (IFMS) for the Magnetic Measurement Lab for the National Synchrotron Light Source II (NSLS-II) project at Brookhaven National Laboratory was delivered and installed in 2012.

Insertion devices (IDs) at NSLS II need to be accurately surveyed using an integrated field measurement system prior to insertion into the storage ring. The IFMS is a fast and precise measurement system required in order to determine the ID magnetic field integrals.

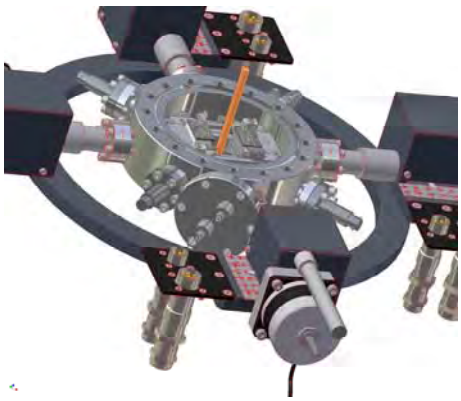
The IFMS consists of a set of long coils supported by two 3-axis X-Y-Z precision linear positioning stages and two precision rotary positioning stages. The PC acts as the primary control unit. Eight servo motor control cards, eight drivers, one metrolab integrator card and a delta-tau motion controller installed to perform remote control and data acquisition.

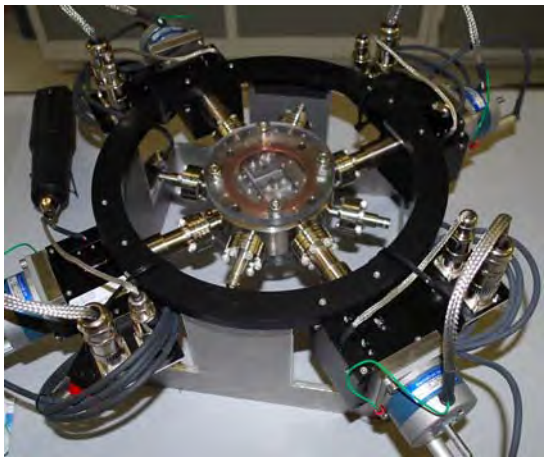
The design included a flip coil, which consists of a long narrow width coil with 20-30 turns that is rotated in the undulator field. Second is a moving coil, which consists of a long board supporting fixed vertical and horizontal coils, 10 and 150 turns, respectively. One leg of this coil is inserted into the ID field and the return path is far outside the field. Finally, a stretched wire similar to the moving coil mentioned above, where one leg of a single turn coil is passed through the field and the return leg is far outside the field.

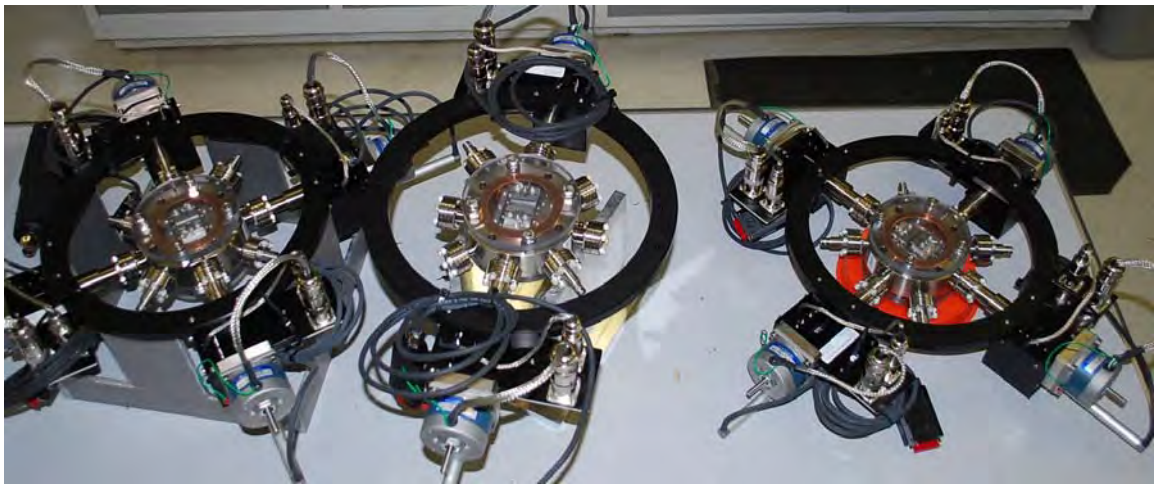
For detailed project information please visit:
http://www.adc9001.com/IFMS-for-NSLS-II

14. Three Sets of Custom UHV Monochromatic Slits Delivered to DLS (UK)

These units consists of vertical and horizontal slit mechanisms, a double-sided flange which houses them, stepper motors, limit switches, and electrical connections for a drain current measurement system. UHV Monochromatic Slits have the capability to monitor beam position. Each of the four blades are individually controlled and motorized. The range of travel for each blade is from –3 mm to +30 mm depending on the size of the configuration (3 mm overlap to 60 mm opening). With modification, the blades can withstand a heat load of 5 watts. This modification precludes drain current measurement.





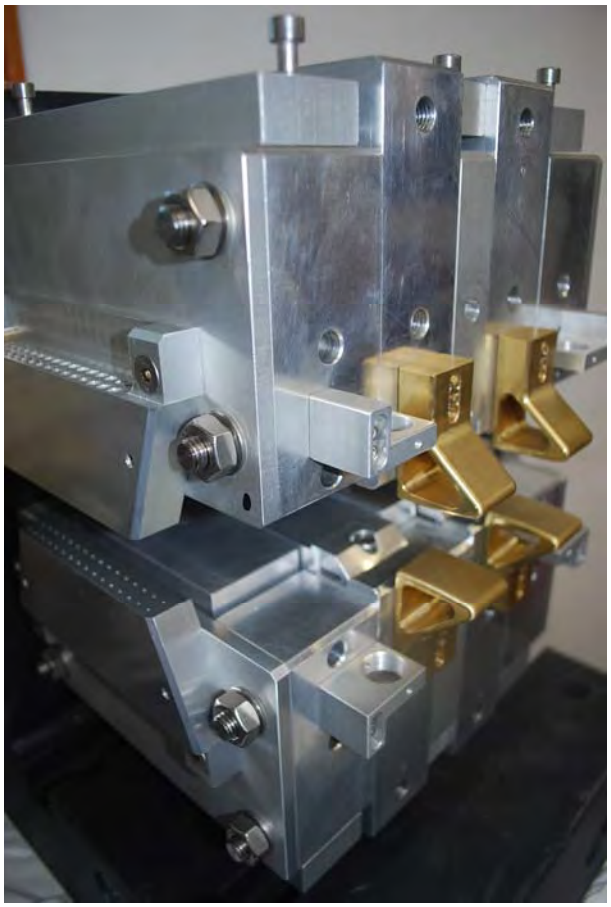


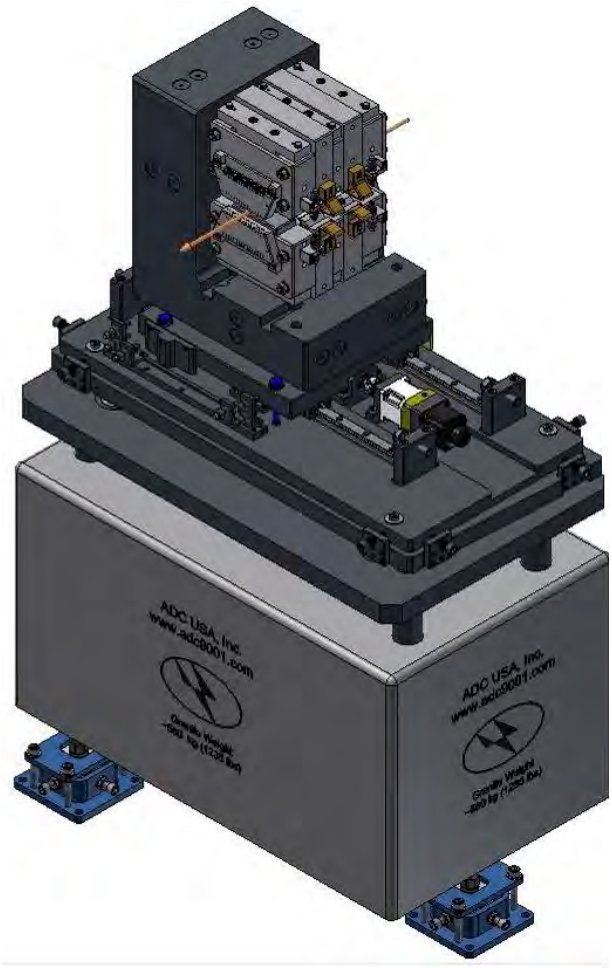
For more information please visit:
http://www.adc9001.com/SLT-300-Series-UHV-Slits

Projects in Progress…

1. Design, Fabrication, Assembly and Shimming of a Number of 3 Pole Wiggler Devices for Brookhaven (NSLS II - USA)

This involves the design and construction of the three pole wiggler which will be used to monitor the beam emittance and provide a broadband source for the National Synchrotron Light Source II at BNL.





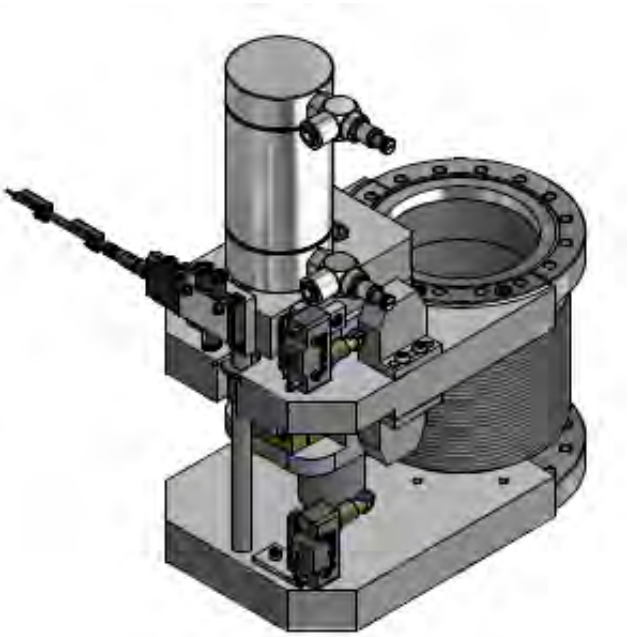
For detailed information on similar wiggler devices ADC has designed and built please visit: http://www.adc9001.com/Wigglers

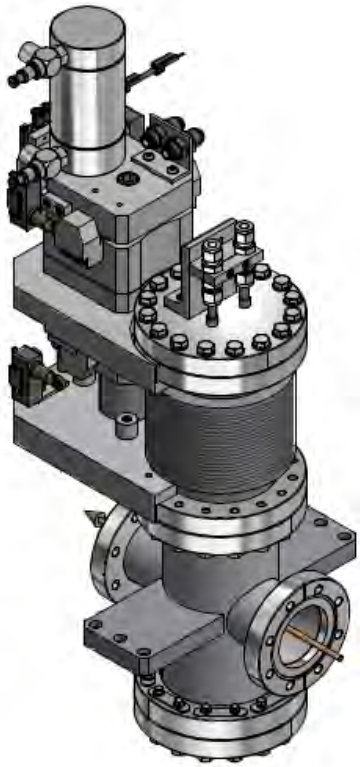
2. Three (3) Photon Shutter Assemblies for Louisiana State University (LSU)

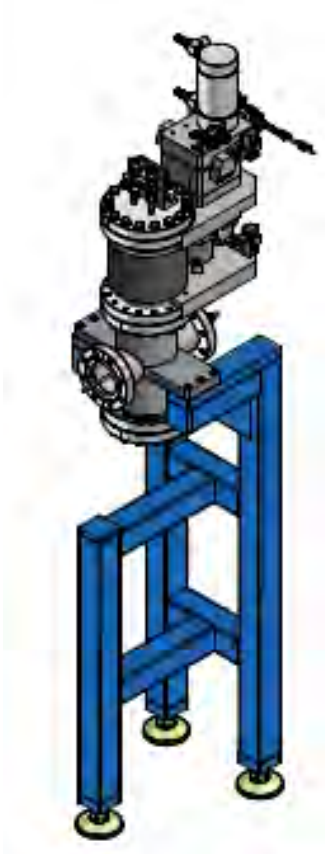
Beam stops are designed as high heat load absorbers to provide effective equipment protection. For applications requiring personnel protection, safety shutters are designed to provide high heat load and radiation absorption. ADC's stops and shutters consist of three major components – a linear pneumatic actuator, water cooled absorber, and a vacuum chamber. These shutters are designed for ease of assembly and servicing!

- White Beam Stop – Safety Shutters
- Mono Beam Shutters
- Ease of Assembly & Servicing
- Designed for over 10 years of maintenance free operation.

Each assembly is vacuum tested to better than 5×10^{-10} torr



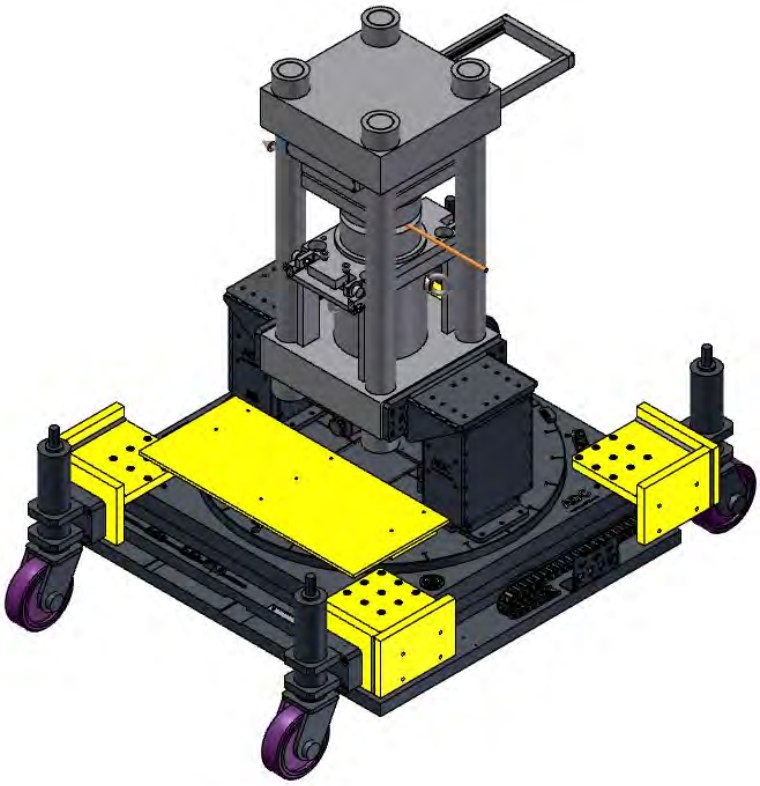




For more information please visit:
http://www.adc9001.com/products/view/459

3. Press Assembly Motion System for Macquarie University

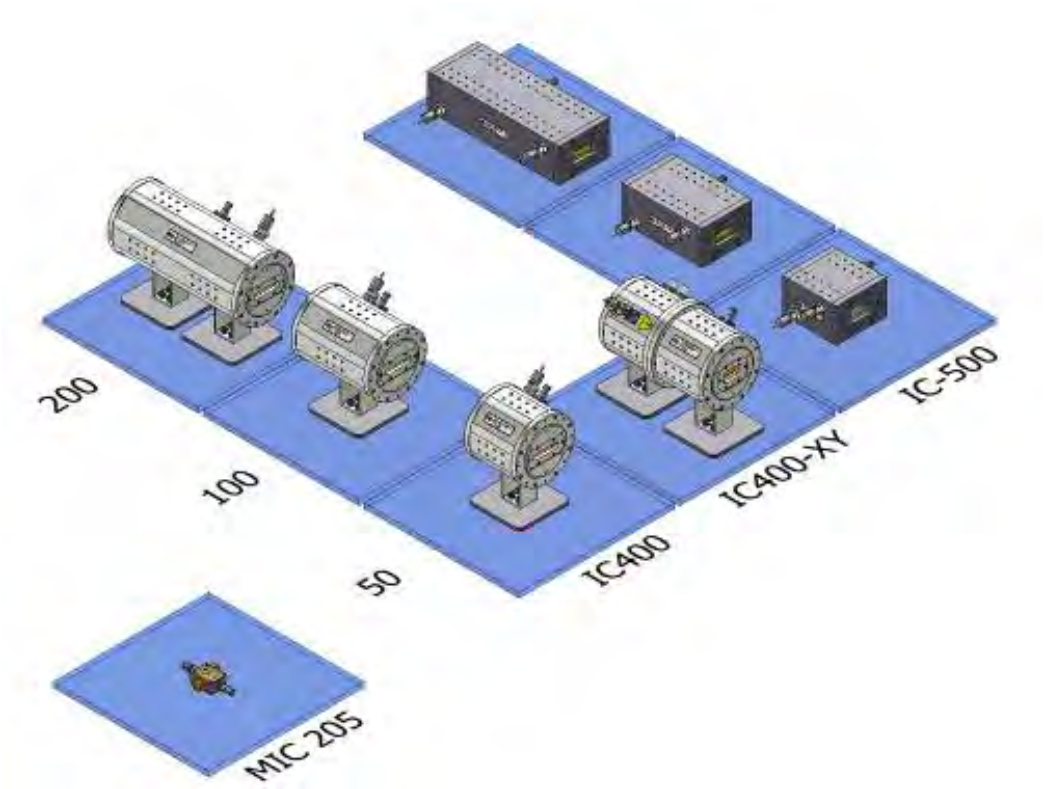
A system was designed for Macquarie University – Australian Synchrotron that allows for multi-axis positioning for a 3,200 lb. press. There are four degrees of freedom for the press motion system. Vertical motion is provided by two ADC utility jacks, each having a load capacity of 25 kN (5,620 lbs). The two jacks are driven simultaneously using a bevel gearbox. Custom linear slides provide motion transverse to the beam and in the beam direction. Linear travel is supported by THK HSR35 guide rails and bearings. A high-load-capacity manual rotation stage allows for rough positioning of the press and sample alignment. Vertical and linear motions are equipped with encoders to provide closed-loop precision motion. Table 1 provides the product description, range of motion, and resolution for each degree of freedom on the press manipulation system.



Latest Product Developments at ADC…

1. ADC is now offering three new types of Ion Chambers:

- IC-400 series (IC-400-50, IC-400-100, IC-400-200, IC-400-XY)
- IC-500 series (IC-500-50, IC-500-100, IC-500-200)
- MIC-205 (Micro Ion Chamber)



IC-400 & IC-500 series ion chambers are designed for precise, low noise x-ray measurement. The device allows users to determine the change in beam position in a single axis by comparing two signals that are created as the beam passes through the Ion Chamber. By connecting two Ion Chambers together at 90° you can determine the horizontal and vertical beam position. The system can be configured for air, vacuum, or ultrahigh vacuum operation through one of three interfaces.

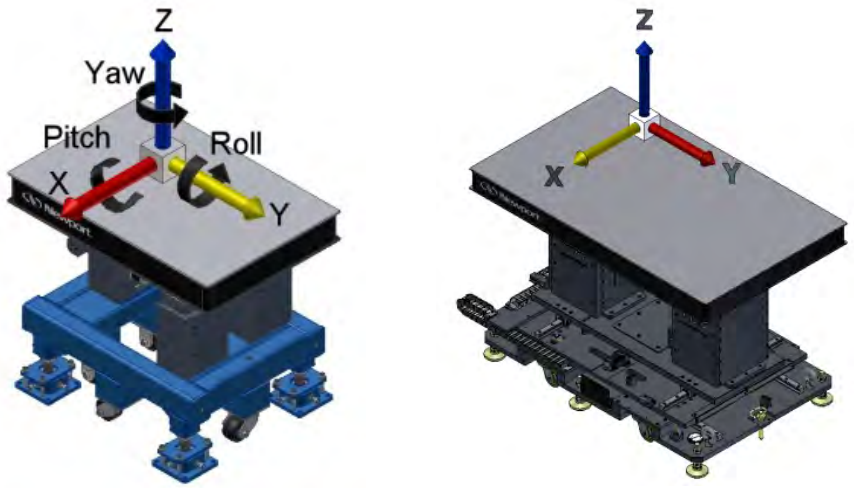
One unique feature of the IC-400 & IC-500 series precision ion chambers is the incorporation of a split collector plate. The electrode is split in a saw tooth configuration with a height of approximately 10mm, 15mm, and 25mm such that, when the differential current is computed, allows use as a beam position monitor. Custom configuration of the window and electrode sizes is available upon request.

For more information and detailed drawings please go to:
http://www.adc9001.com/products/show_list/id/173

2. New High Load High Precision Motorized Optical Table

ADC is offering two series of High Precision Motorized Optical Tables; Six Degrees of Freedom and Three Degrees of Freedom. Features include:

- Load capacity 1000 kg (2205 lbs.) & 3000 kg (6614 lbs.);
- Motion Resolution: 0.1µm (with Renishaw Linear Optical Encoder and 50:1 Gear Ratio);
- Manual adjustments and lock down for feet;
- Large casters for easy handling;
- Newport Corporation Research Grade breadboards with a grid of M6 tapped holes, and;
- Can be custom designed to fit customer specification.



Our High Precision Motorized Optical Tables are being used at many of the world-class research facilities around the world. This list includes: NASA, Los Alamos National Lab, Argonne, Brookhaven, CAMD, SLAC, ELETTRA, BESSY, DESY, MAX Lab, ANKA, CLS, Spring-8, DLS, BNL and many other facilities. Each actuator may be equipped with an optional linear encoder.

For more information on our High Precision Standard Optical Tables please go to:
http://www.adc9001.com/products/show_list/id/105

ADC also custom designs complex high-precision components and instruments (UHV and High Vacuum, Active vibration, sub-µ precision, custom control/driver and control software based on customer requirements….) for Synchrotron, High Energy Physics Facilities, commercial, academic and government agencies, worldwide.

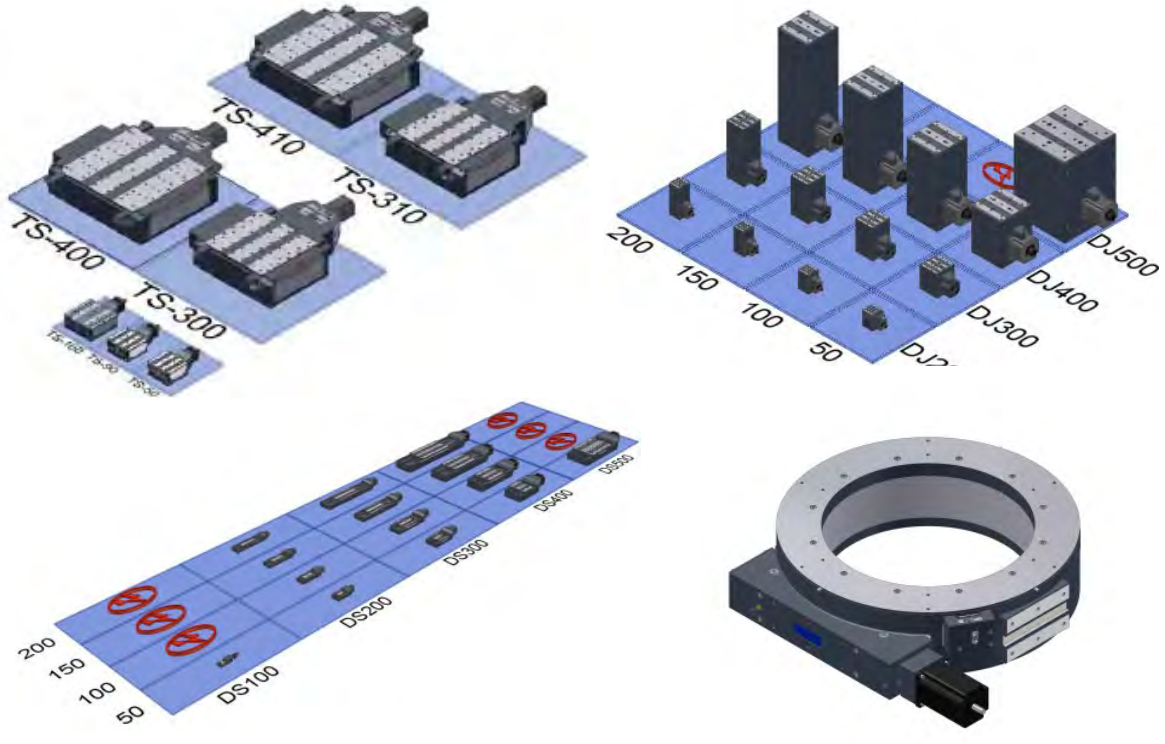
For more information on our High Precision Motion Systems please go to:
http://www.adc9001.com/products/show_list/id/106

Please send us your specifications and let us be a part of your team in developing your next instrument. I would also like to extend an invitation to you, to visit us at any time for a tour of our facilities and to show you our quality control, engineering, manufacturing and assembly, as well as our testing procedures.

3. Motorized High-precision Stages

ADC offers a family of high precision stages integrated by OEM motion systems and by leading semiconductor equipment manufacturers for wafer inspection, automations and robotics to motion systems used in astronomy research. These stages include; high-precision slides, vertical stages (Jacks), goniometer (Tilt), rotation, and actuators in different sizes and load capacity. Our stages are driven by high class preloaded ballscrew coupled to a high torque 200 step per revolution stepper motor which can be run in full, half, or microstepping mode to meet your resolution requirements. ADC's precision rotation stages are built upon an industry leading, preloaded, duplexed angular contact bearing set. These stages not only give an exceptionally high running accuracy, but allow for large radial and thrust loads as well. Each stage is driven by a precision ground worm gear set and a high resolution, high torque stepper motor. ADC also offers custom engineered motion systems that are designed and built for system level performance for your application.

- Sub - Micron precision
- Encoder option
- Ultra High Vacuum (UHV), High Vacuum (HV) and Rough Vacuum (RV) option
- Customized to Customer Specifications; travel, load bearing, etc.



For more information please visit:
http://www.adc9001.com/products/show_list/id/104

4. X-Ray Optics System Options from ADC

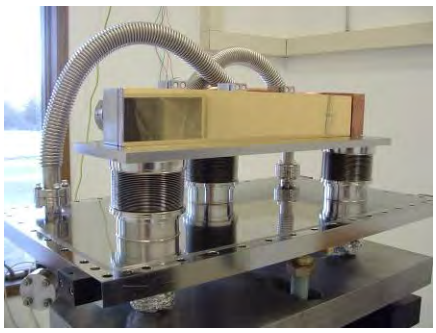
ADC's standard mirror system consists of four primary subcomponents: the mirror optic, its positioning system, a vacuum chamber, and the support structure. Additional features ADC provides for mirror systems are bending mechanisms for the mirror optic and mirror cooling system for high heat load applications.

ADC is now offering customers two options for the positioning system of our mirrors: stacked linear motion or a hexapod positioning system. Each system provides six degrees of freedom for the mirror optic and is configured to meet the motion specifications of the user. There are advantages and disadvantages to using a linear motion system vs. a hexapod that need to be considered. Table 1 provides a description and comparison of key performance features for the stacked linear motion and hexapod mirror motion configurations.

Table 1. Comparison of features for stacked linear motion and hexapod mirror systems.

	Stacked Linear Motion	**Hexapod**
Cost	**Lower:** The system is comprised of several short-travels, ball-screw driven stages that are guided by precision crossed-roller bearings. This makes for a simple, but effective motion system.	**High:** Precision bearing mounts and six precision linear actuators drive the motion of the platform. Complex controls and software are used to manipulate the platform.
Stiffness	**Good:** Bottom stage supports the weight of two stages above as well as the load from the mirror optics. Thus, the center of gravity for the payload on the bottom stage is located far above stage platform. Upper stages are not fixed to a rigid support.	**Excellent:** Actuators work in parallel and see only axial loads. This provides the mirror optics with a very stiff support structure. The six actuators share the payload.
Motion Path	**Continuous Scanning:** Linear motion provides smooth scanning in the horizontal plane.	**Intermittent Scanning:** Synchronous movement of the legs causes tip and tilt of the mirror optics platform. Smooth scanning is not possible.
Controls	**Simple:** Motions are controlled independently. Easy to debug the system and to physically measure position. Relationship between linear motion and angular displacement is simple.	**Complicated:** Each degree-of-freedom is co-dependent. Motion of the system is not as straight forward and it is difficult to determine source of position errors.
Accuracy	**Excellent:** Motions are performed by fewer actuators. This reduces the number of sources for positioning error to 2 or 3 linear actuators.	**Average:** Any motion is a result of motion from 6 actuators that each contribute to the overall position error of the mirror optic.

The sections that follow provide further description of the configurations and design of ADC's mirror systems. A detailed overview of mirror support structure, motion system configuration, and typical specifications of our mirror systems is discussed. ADC also provides mirror systems with bending mechanisms and cooling systems to meet the user's needs. A brief description and examples of these options are included.



Stacked Linear Motion

Our stacked linear motion mirror system consists of a single large vacuum chamber for the mirrors, with independent motion systems to each mirror. Figure 1 shows an example of ADC's standard design for a UHV mirror with stacked linear motions. All axis are motorized by the

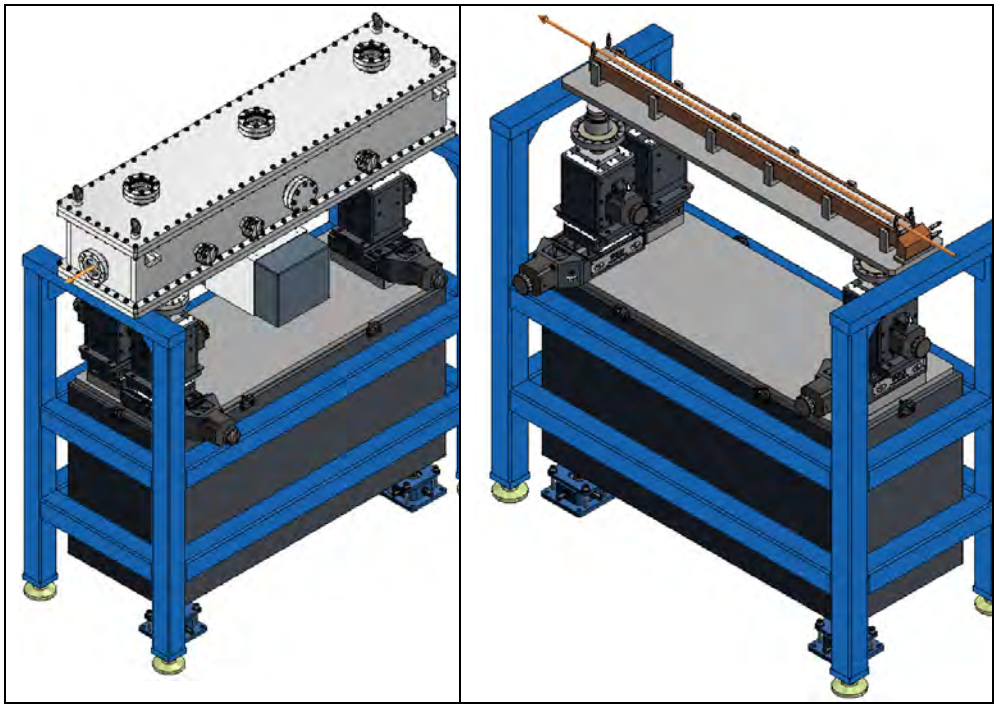


Figure 1 ADC Mirror System comprised of motorized stacked linear motions, granite plinth to support the motions, and UHV chamber mounted to steel framework. The steel frame is filled with sand to dampen floor vibrations. Kinematic feet below the granite plinth allow for adjustment of the mirror to its nominal position.

The nature of the motions (for example the X stages work together to provide an X motion and in opposition to provide a yaw motion). The mirror optic is mounted to a base plate within the vacuum chamber. This base plate is supported kinematically and isolated from the vacuum chamber via a set of bellows that allow for motion of the three support posts. Figure 1 shows a cross-section of ADC's motion bellows assembly that is used to transfer motion from the out-of-vacuum linear stack to the mirror base plate. The base plate (via the bellows assembly) is positioned by the set of stacked linear (XYZ) motorized motion stages. Linear motions with resolutions of a few microns are typically achieved without micro-stepping or gear reduction. Sub-micron motions are achieved with either microstepping or gear reduction. Table 1 shows typical motion specifications for a mirror with 50:1 gear reduction. Angular motions are achieved by the equal and opposite motions of pairs of linear

stages, for example pitch is produced by motions of a pair of linear slides separated by a distance roughly the length of the mirror baseplate.

Table 2: Performance Specifications for a 6 DOF Stacked Linear Motion Mirror System

Motion*	Range	Resolution	Repeatability
X (Transverse to Beam)	50 mm	0.1 µm	± 0.5 µm
Y (Vertical)	50 mm	0.05 µm	± 0.5 µm
Z (Beam Direction)	50 mm	0.1 µm	± 0.5 µm
Pitch (Rot. About X)	100 mrad	0.05 µrad	± 0.5 µrad
Roll (Rot. About Z)	580 mrad	0.32 µrad	± 1.6 µrad
Yaw (Rot. About Y)	100 mrad	0.1 µrad	± 0.5 µrad

*Linear stages with 50:1 gearing used for motion specifications; different gear ratios available to meet customer specifications. Angular displacement and resolution based on 1m distance between motion stacks.

The vacuum chamber is mounted rigidly to a steel frame that is filled with sand to dampen vibrations from the facility floor. A large granite plinth supports the motion systems. This provides a large mass to absorb floor vibrations and is a stable support for the mirror optics. The granite plinth is mounted to the floor by adjustable feet as used for our much more massive undulators. The feet allow for course adjustment of the motion system and mirror optic. Small adjustments on the chamber support frame provide for a fine adjustment of the chamber. This allows for mating up to existing vacuum chambers and beam pipes. The UHV mirror vessel is fabricated by one of the many experienced vendors in this field (Nor-Cal, MDC, Cryogenic & Vacuum Tech., Trinos, KJ Lesker, etc.) and assembled in our clean room environments.

Hexapod Motion System

The hexapod motion mirror system provides six degrees-of-freedom using six synchronously moving linear actuators. Figure 3 shows an example of ADC's design for a UHV mirror system with hexapod positioning. The hexapod motion system benefits from excellent stiffness of the axially loaded actuators. Each end of the linear actuators are mounted to granite platforms. The vacuum chamber and mirror assembly are mounted directly to the upper platform. Depending on the size of the mirror, the vacuum chamber can be mounted on a separate steel frame similar to our stacked linear motion mirror system. Translation and rotation come from the synchronous motion of the six actuators. Complex controls position the center of the platform and manipulate the platform to the desired pitch, roll, or yaw. Motion specifications for a hexapod mirror system are given in Table 3.

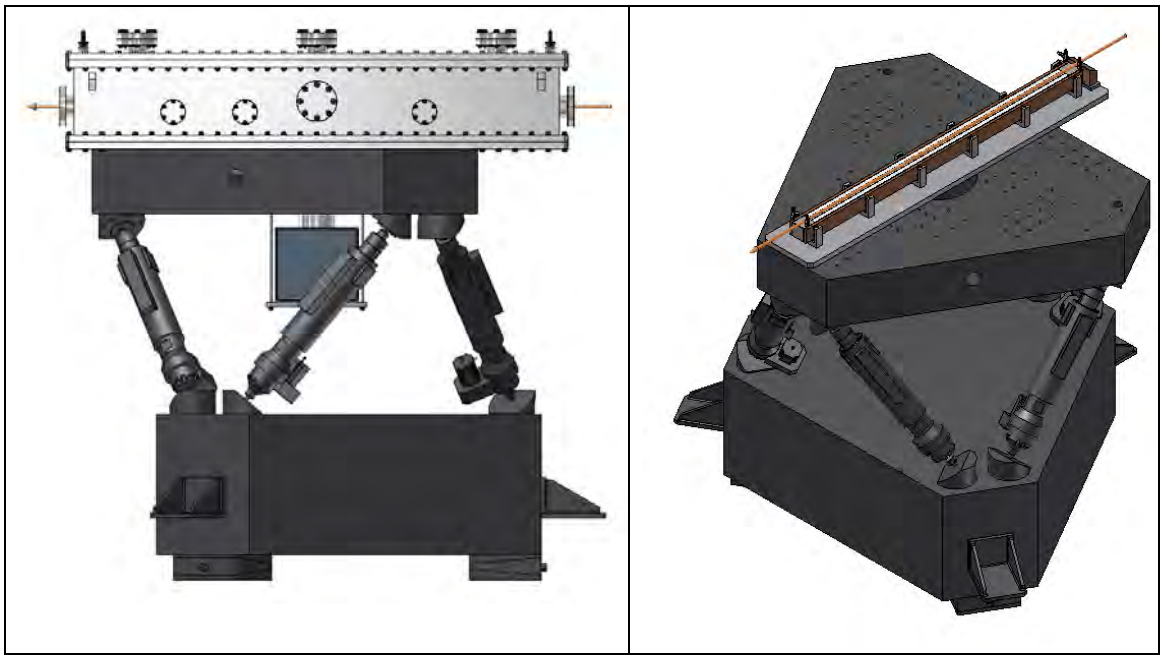


Figure 2. ADC Mirror System with a hexapod motion system. Linear actuators work together to provide six degrees-of-freedom for the optical surface. Both the mirror and UHV chamber are mounted directly to the platform. Other options, such as a separate steel frame to support the chamber are available.

Table 3: Performance Specifications for a Hexapod Mirror Motion System

Motion	Range*	Resolution	Repeatability
X (Transverse to Beam)	130 mm	0.1 µm	± 0.5 µm
Y (Vertical)	100 mm	0.1 µm	± 0.5 µm
Z (Beam Direction)	130 mm	0.1 µm	± 0.5 µm
Pitch (Rot. About X)	105 mrad	0.5 µrad	± 2 µrad
Roll (Rot. About Z)	105 mrad	0.5 µrad	± 2 µrad
Yaw (Rot. About Y)	105 mrad	0.5 µrad	± 2 µrad

*Performances are specified for single axis motions, with all other axes at midrange, for a rotation center positioned at the center of the upper platform.

For more information and detailed drawings please go to:
http://www.adc9001.com/Mirror-Systems

5. Ultra-High Precision Slits

ADC offers the most complete set of ultra-high-precision slits from monochromatic to white beam.

- Micron precision
- Encoder option
- Ability to monitor the beam
- Best slit blade edges in the synchrotron community!!!
- Blade material; Tungsten or Tantalum, Cadmium, Boron Nitride
- Blades can go "past closed" without clashing (Overlapping/Zero beam).
- FEA analysis for thermal and mechanical
- Customized to customer specifications; flange size, blade material, etc.

All models use cross-roller bearing technology for exceptional straightness of travel. All of these slits use standard micro stepped stepper motors that could be controlled with a wide array of controllers/drivers available on the market. Our slits are being used in many of synchrotrons around the world (APS, NSLS, ALS, DLS, NSRRC, BESSY, DESY, CHESS, ESRF, BSRF, CAMD, NSRL, PAL, LNLS, CLS, SSRF, ANKA, KEK, SPring-8, ASP, ELETTRA, MAX-Lab, …)

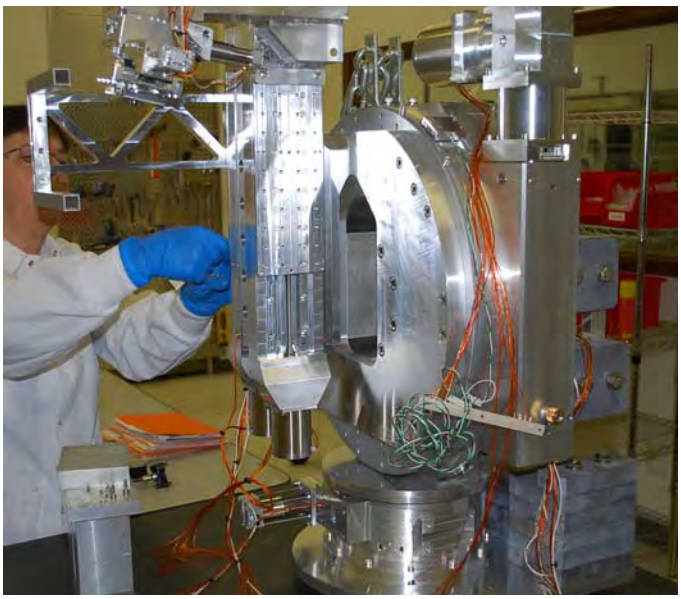
We now do 100% inspection on all our slits blades being sold. For a copy of the report please contact ADC.

For more information and detailed drawings please go to:
http://www.adc9001.com/SLITS

6. High Precision Vacuum Compatible Motion System

ADC's high precision vacuum compatible stages are designed and built depending on the application. Notes:

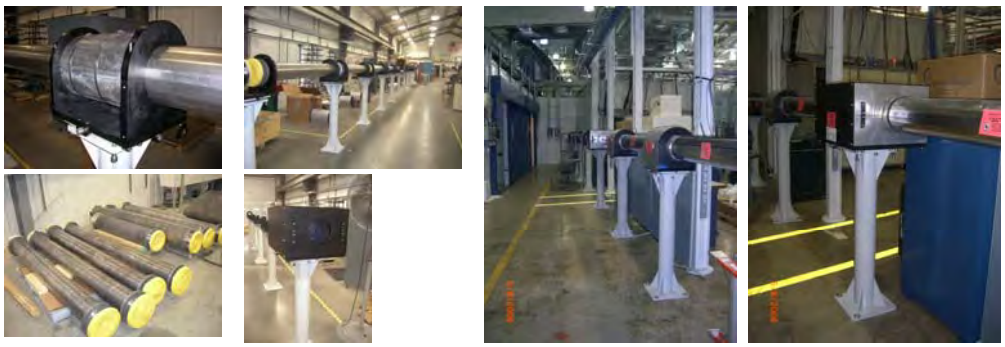
- Parts are not anodized.
- All cavities are vented to eliminate outgassing
- Components are assembled using special, clean-room compatible screws (Class 100).
- All stages can be equipped with vacuum compatible encoders from Renishaw and limit switches.
- All stages can be equipped with vacuum compatible motors from Phytron.
- The guides and ball screw are made from stainless steel, with dry lubricant applied.
- Three vacuum levels are offered: LOW VACUUM (10 -3 mbar vacuum), High VACUUM (10 -8 mbar vacuum), UHV (10 -10 mbar vacuum).



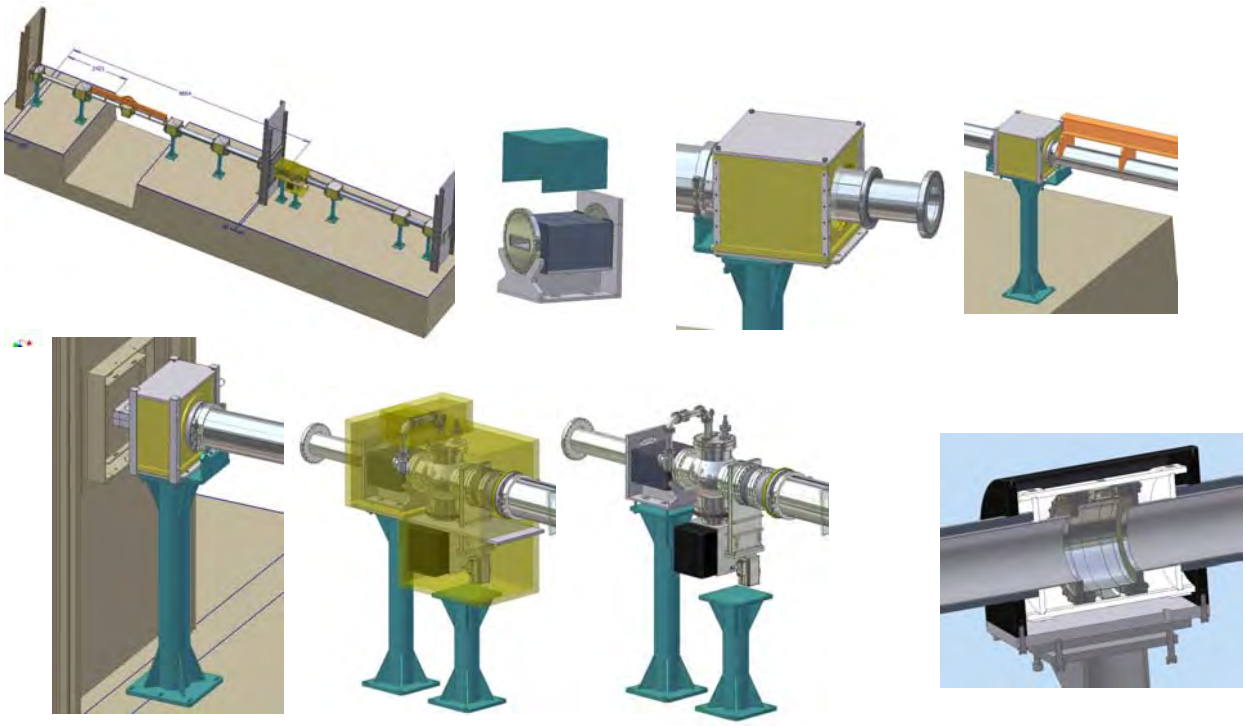
For more information and detailed drawings please go to:
http://www.adc9001.com/products/category/101

7. Beam Pipes

ADC delivers high quality radiation leak tight beam pipes with a proven track record, used for front and back end synchrotron equipment. The pipes are manufactured to exact customer specifications and requirements, and come with or without lead shielding. Each stand consists of a rigid steel structure, with adjustable height. Each assembly undergoes complete vacuum leak testing.



Shielded transport pipe with shielded stand assembly for Advanced Photon Source (APS)



Custom Shielded transport pipe with shielded stand assembly for Canadian Light Source (CLS)

For technical and ordering information please go to:
http://www.adc9001.com/index.php?src=04-beam-pipes

8. Insertion Devices and Magnetic Measurement Systems

ADC has designed, built and delivered Insertion Devices and Magnetic Measurement Systems to such facilities as; MAX-Lab (EPU, Planar-2, and Measurement System), ALBA and Australian Synchrotron Project (Wiggler), BNL (Cryo In-Vacuum), SSRF (In-Vacuum – 2, and Measurement System), PAL (In-Vacuum and Measurement System), NSRRC (In-Vacuum), and SRC (Planar and EPU). ADC can provide "Turn-Key" Insertion Devices and Magnetic Measurement Systems complete with in-house and customer site training.

Please feel free to contact us to discuss and provide a rough schedule and cost for the following items:

- Wiggler Insertion Device
- Undulator Planar Device
- Elliptical Polarized Undulator (EPU)
- In-Vacuum Undulator
- In-Vacuum Cryo Cooled Undulator
- In-Vacuum Elliptical Polarized Undulator (EPU)
- Supper Conductive Undulator
- Insertion Device Magnetic Measurement System

You can access and download more information/publication on previous Insertion Devices we have delivered by going to: http://www.adc9001.com/products/show_list/id/113

9. ADC Standard Motor Controls and Driver

Galil

DMC-40x0 motion controller

The DMC-40x0 motion controller is Galil's highest performance, stand-alone motion controller. It belongs to Galil's latest generation motion controller family: the Accelera Series, which accepts encoder inputs up to 22 MHz, provides servo update rates as high as 32 kHz, and processes commands as fast as 40 microseconds-10 times the speed of prior generation controllers.

The DMC-40x0 is a full-featured motion controller packaged with optional multi-axis drives in a compact, metal enclosure. The unit operates stand-alone or interfaces to a PC with Ethernet 10/100Base-T or RS232. The controller includes optically isolated I/O, high-power outputs capable of driving brakes or relays, and analog inputs for interfacing to analog sensors. The DMC-40x0 controller and drive unit accepts power from a single 20-80 VDC source. The DMC-40x0 is available in one through eight-axis formats, and each axis is user-configurable for stepper or servo motor operation.

With a powerful RISC processor, the DMC-40x0 controllers provide such advanced features as PID compensation with velocity and acceleration feedforward, program memory with multitasking for simultaneously running eight applications programs, and uncommitted I/O for synchronizing motion with external events. Modes of motion include point-to-point positioning, position tracking, jogging, linear and circular interpolation, contouring, electronic gearing and ecam.

Like all Galil controllers, programming the DMC-40x0 is simplified with two-letter, intuitive commands and a full set of software tools such as GalilTools for servo tuning and analysis.

10. Computer Hardware

Dell

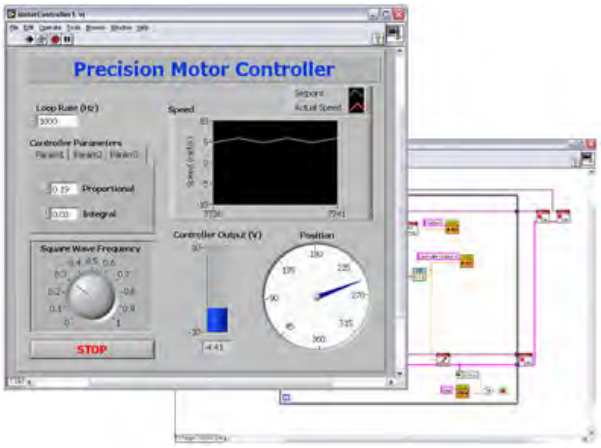
Personal Computer

- Intel® Core™ i3-2100 processor (3MB Cache, 3.10GHz)
- 2GB Dual Channel DDR3 SDRAM at 1333MHz - 2 DIMMs
- 250GB Serial ATA Hard Drive (7200RPM) w/DataBurst Cache™
- Genuine Windows® 7 Professional SP1, 64bit
- Dell E Series E2011H 20"W Monitor, 20.0 Inch VIS, Widescreen, VGA/DVI

11. User / Software Interface

National Instruments

LabView



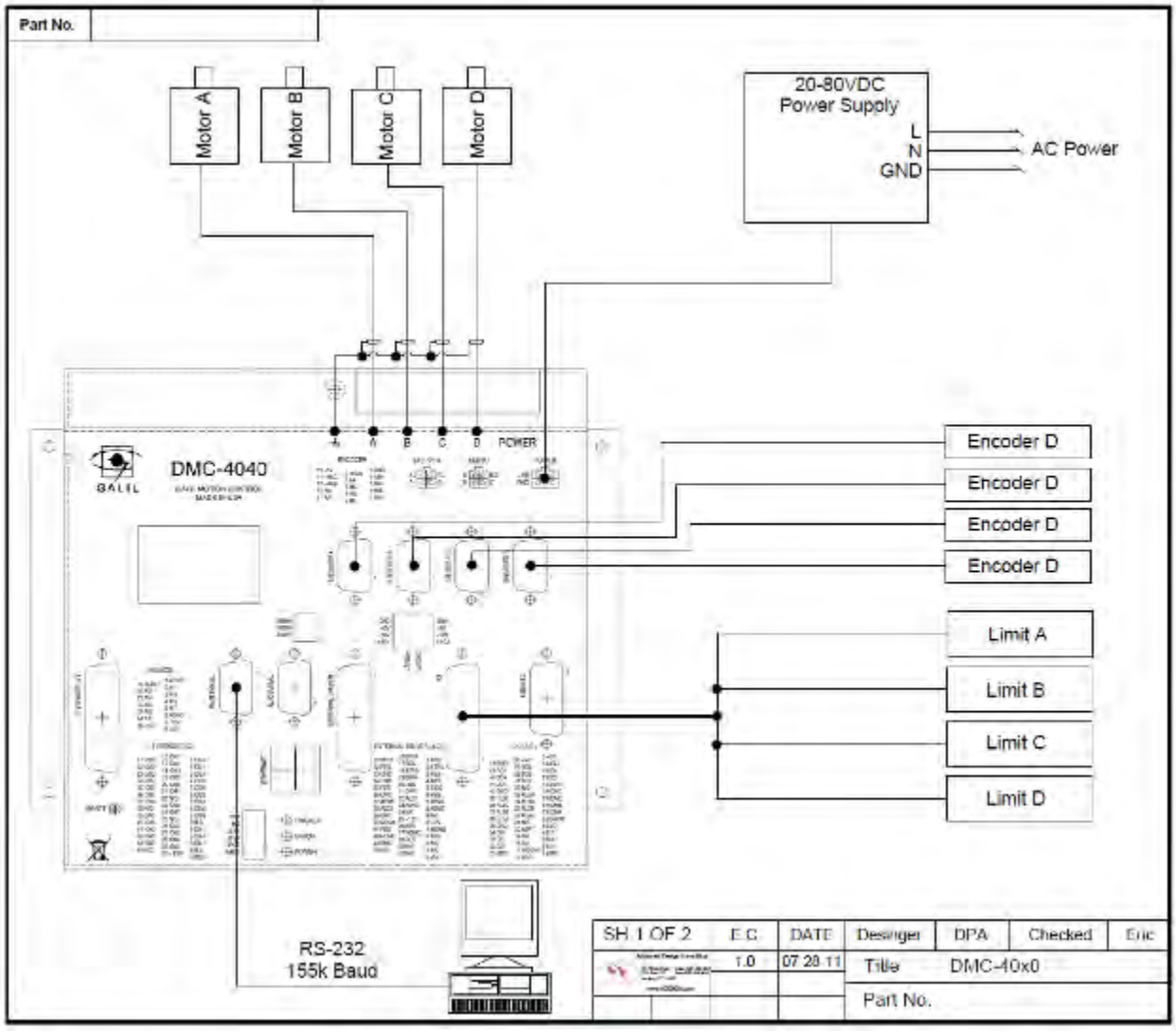
LabVIEW is a graphical programming environment used by millions of engineers and scientists to develop sophisticated measurement, test, and control systems using intuitive graphical icons and wires that resemble a flowchart. It offers unrivaled integration with thousands of hardware devices and provides hundreds of built-in libraries for advanced analysis and data visualization – all for creating virtual instrumentation. The LabVIEW platform is scalable across multiple targets and OSs, and, since its introduction in 1986, it has become an industry leader.

Graphical User interface for the motion control include

- Data Display
- Ability to move individual axis
- Absolute move of axis
- Relative move of axis
- Home individual axis
- Encoder feedback
- Limit switch detection
- Easy install on a Windows OS platform

12. Hardware Schematic

DMC-40x0 controller, Motor, limits, & encoders



13. EPICS Interface

The Gallil DMC-40x0 controller/driver is already supported by EPICS Ethernet drivers. This means the DMC-40x0 controller will communicate with the local IOC. ADC will provide the EPICS database for incorporation into the local IOC EPICS program. This will consist of a list of input and output variables with their units and range of value. Each blade can be controlled independently.

For more information on ADC's products please go to: www.adc9001.com
Or contact ADC at (607) 533-3531 or email: adc@adc9001.com