



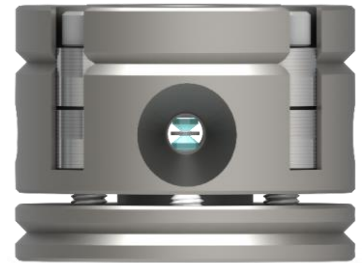
Diamond Anvil Cells by DAC Tools





LARGE OPENING DIAMOND ANVIL CELLS

DACTools manufactures a variety of Diamond Anvil Cells optimized for different high-pressure experiments. While “Standard” Symmetric DAC remains popular and we do supply different versions of this DAC (i.e. Imperial 1.875”, Metric 48 mm, Metric Mini 40 mm, regular and shortened), there are several modifications of larger openings symmetric DACs which are gaining popularity.



The Spherical Seat DACs (SSDAC) with 70 and 80 degrees real symmetric X-ray opening were specifically designed for single crystal x-ray diffraction at synchrotron facilities and on a laboratory-based (i.e. Rigaku) diffractometer and for use with Boehler-Almax type conical seats where diamond tilt alignment can be critical. The design allows the cell to be used with two membranes (compression and decompression) and still keep up to 70-80 degrees real symmetric x-ray opening. SSDAC-70 has ample space inside for small resistive heaters.

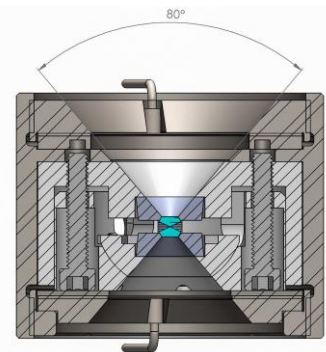


SSDAC-70/80 is a single crystal diffraction DAC, but it can be used with a variety of experimental techniques where large symmetric opening is required such as X-ray total scattering measurements, Brillouin and other optical spectroscopies as well as powder x-ray diffraction. If 80 degrees symmetric opening is not absolutely crucial, a longer (and thus a bit more stable) 70 degrees configuration (SSDAC-70) is preferable, especially for Megabar range.

The version of such DAC without diamond tilt control is called iBX-70/80 (“imperial BX” DAC) and is an optimized upgraded version of BX-90 making the DAC more practical and functional compared to the original BX-90 DAC. The optimized 50 mm metric version (mBX-60/70/80) is under active development.

SSDAC-70/80 and iBX70/80 have the same diameter (although slightly different height) and hole pattern and are compatible with equipment designed for this DAC family (DAC holders, single and double membrane cans and pressurization frames, gearboxes for gas-loading systems, etc.)

With proper diamond culet size (<250 μm), diamond alignment, and sample preparation the iBX and SSDAC cells can be routinely used in sub-Megabar and Megabar pressure range.



All above mentioned DACs allow for multiple ways of pressure control – either with screws, mechanical gearboxes, or with membranes (see e.g. *Sinogeikin et al., Rev. Sci. Instruments 86, 072209, 2015*). The DACs can be preloaded to starting pressure with four screws and then engaged with remote pressure control devices. The DACs can be supplied as stand-alone versions, with a single membrane canister, or in double-membrane symmetric configuration which provides

up to 80 degrees real symmetric X-ray and optical opening with proper choice of diamond anvils, diamond seats and membranes.

A new addition to large opening / single crystal DACs is Mini-BX80 Diamond Anvil Cell. This is a modification of a compact (39mm OD) *Mini-BX90 DAC* optimized for better stability, convenience, and versatility: it can accept a variety of diamond seat combinations while remaining very compact and stable, can be easily integrated with remote membrane pressure control, and can be used in exotic sample environments such as a compact cryostat for double-sided laser heating.

All these DACs can be supplied with pins for mounting on conventional goniometers and other custom furnishings for easier DAC handling.





PANORAMIC DIAMOND ANVIL CELLS

Two-fold Panoramic DAC for Inelastic Scattering, Radial Diffraction, and Tomography

Old Style Two-fold panoramic DACs provide 140 degrees symmetric radial opening in horizontal direction and up to 68 degrees opening in vertical direction. In many experiments they are still a primary choice for radial x-ray diffraction measurements, X-ray tomography, inelastic X-ray scattering measurements with or without polycapillary optics, NRIXS measurement with large APD detectors, and other techniques requiring large angle panoramic view in radial geometry and easy access to the sample. The DACs can be integrated with compression and / or decompression membrane systems.



Compact DACs for Inelastic scattering, Radial diffraction, Tomography, and Time-resolved experiments

DACTools offers a family of compact panoramic DAC, both 2-fold and 4-fold, which provide up to 90 degrees radial opening (both vertical and horizontal) and can be used for a variety of techniques such as radial diffraction, X-ray tomography, X-ray inelastic scattering, and other techniques, including non-X-ray ones. The DAC can be easily combined with a compression / decompression membrane drive or a piezoelectric drive in either compression or decompression mode and used for x-ray diffraction measurements in radial geometry in static or dynamic (e.g. cyclic pressure variation) regime.



Wide opening (150°) Diamond Anvil Cell for Tomography and Radial diffraction

TOMO150 compact panoramic 2-fold Diamond Anvil Cell was primarily designed for x-ray tomography but is widely used for a variety of other experiments. It provides 150 degrees of unobstructed symmetric radial opening in horizontal direction and up to 50 degrees in vertical direction (depending on the diamond + seat configuration). It has the same diameter and screw pattern as the popular GL-CIW Standard Symmetric DAC which makes integration of this DAC into experimental infrastructure (DAC holders, gearboxes, membrane systems, etc.) for Symmetric DACs relatively easy and straightforward.

The DAC is suitable for multiple experimental techniques such as X-ray diffraction in radial and axial scattering geometry, inelastic X-ray scattering, X-ray tomography, as well as optical measurements such as Raman spectroscopy, among others. Properly prepared DACs can readily reach and exceed megabar pressures. If hydrostatic conditions are required – the DAC can be loaded with inert gases as pressure medium in GSECARS / APS type and compatible gas loading systems.





Symmetric Diamond Anvil Cell Imperial and metric versions, 1.875 in. / 48.0 mm OD

Models STD-SYM-DAC / SYM-DAC-48mm

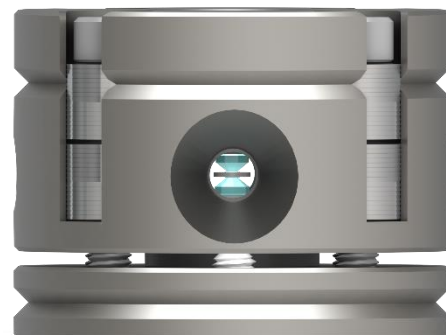
The Symmetric Diamond Anvil Cell (DAC) is perhaps the most popular DAC in the World. It is compact, versatile, simple to operate, user-friendly, and is easily adaptable to multiple experimental environments. The Symmetric DAC can be used for a multitude of laboratory-based optical spectroscopies (e.g. Raman, Brillouin, etc.), electric measurements, as well as X-ray diffraction, inelastic X-ray scattering, and a vast variety of different experimental techniques. With proper diamond culet size ($<250\ \mu\text{m}$), diamond parallelness and alignment, as well as proper sample preparation, the DAC can readily reach megabar, and even multi-megabar pressures.

The DAC can be provided with different tightness depending on the intended pressure range and experimental conditions. Also we can provide modified versions of the DAC – e.g. with shortened cylinder for smaller working distance or with built-in containment for special experiments.

The symmetric DAC is typically made of Stainless Steel 440C or Vascomax C-300/350 superalloy hardened and tempered to HRc 56-58 for optimal properties. The DAC can be used at both cryogenic conditions down to $<4\ \text{K}$, as well as to high temperatures with resistive heating (with special setups and environments).

The DACs allows for multiple ways of pressure control. Typically the pressure in the DAC is controlled by four #10-32 / M5x0.8mm screws – two left and two right (to minimize relative rotation of the diamonds during pressure increase). Nevertheless the Symmetric DAC can be easily integrated with remote pressure control devices and the pressure in the DAC can be controlled with either mechanical gearbox, piezo control, or membrane (see e.g. [Sinogeikin et al., Rev. Sci. Instruments 86, 072209, 2015](#)).

Recently DAC Tools introduced a double-membrane compression / decompression system which allows very accurate remote pressure control on pressure increase and decrease. This capability is extremely valuable in harsh environments, such as cryostats. The new double-membrane setup for room temperature allows symmetric 60 degrees opening (on both sides of the Symmetric DAC) for optical spectroscopy and x-ray diffraction (providing the proper choice of diamonds and diamond seats). The remote pressure control system can be provided separately.





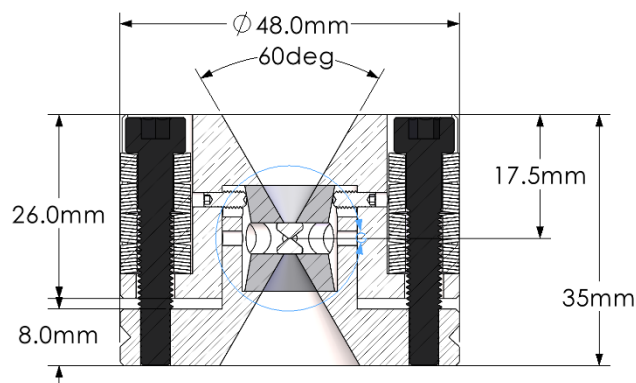
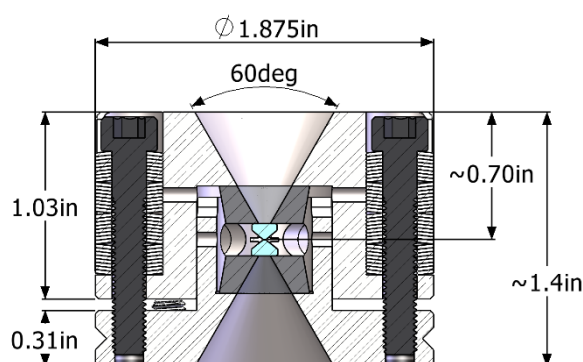
Specifications of Symmetric Diamond Anvil Cell

Main DAC Specifications

- Height: ~1.4" / 35-36 mm)
- Diameter: 1.875" / 48.0 mm
- Working distance: ~17-18 mm
- Mass: ~ 400 g
- Optical angles: 60 degrees
- Seats: Tungsten carbide (typ.), cBN optional
- Screws: 10-32 x 1.125" / M5x0.8 – 25-30mm
2x left and 2x right
- Spring washers: 0.375" OD, 0.190" ID,
0.015-0.020" thick /
10.0 mm OD, 5.2 mm ID, 0.5 mm thick
- Diamond seat diameter: ~0.5" / 12.5-13.0 mm
Max 0.52" / 13.4 mm
- Minimum height of two seat + diamonds: 0.53" / 13.5 mm
- Maximum pressure: 200-300 GPa with proper diamonds and alignment

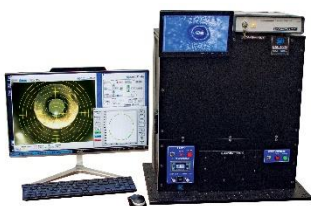
DAC Material Properties

- Type: Stainless 440C or Vascomax C300/350 (Maraging steel)
- Ultimate strength: 1750-2400 MPa (typ)
- Yield strength (0.2%): 1280-2340 MPa (typ)
- Hardness Rockwell C: 56-58
- Magnetic?: Yes



Related equipment

Laser drilling systems



Ruby pressure systems



Membrane P Control



For more information please visit www.DACTools.com



Nov. 2023

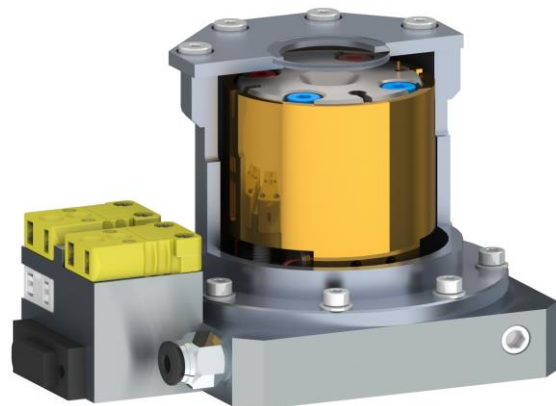


MINI SYMMETRIC (40mm) DIAMOND ANVIL CELL

Model 40mm-Mini-SYMM-DAC-REG(SHORT)-SS440C

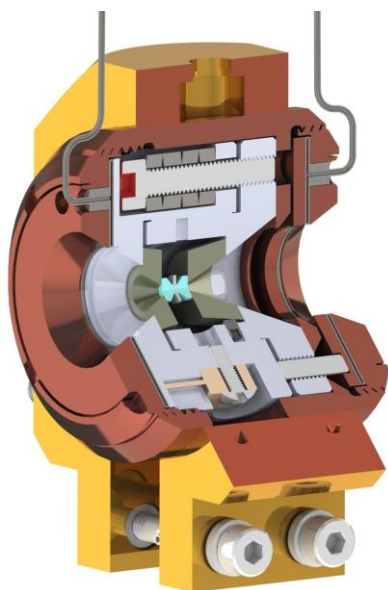
The Symmetric Diamond Anvil Cell (DAC) perhaps remains the most popular DAC in the World. It is compact, versatile, simple to operate, user-friendly, easily adaptable to multiple experimental environments and can be used for a multitude of optical and X-ray studies and a large variety of different experimental techniques. With proper diamond anvils, alignment and sample preparation the DAC can readily reach megabar pressures (>100 GPa).

DACTool's Mini Symmetric (40mm) DAC is a direct derivative of the classic 1.875" / 48 mm symmetric DAC where unnecessary outside material was removed making it about 5 mm shorter (9 mm for shortened version) and ~8 mm smaller in diameter, thus reducing the mass of the DAC by ~50%. At the same time the inner diameter and height of the piston remain about the same as in classic symmetric DACs allowing to use standard size diamond seats and anvils. Moreover, thicker piston walls and special honing and fittings techniques make this Mini Symmetric DAC even more robust and stable than the original Standard Symmetric DAC.



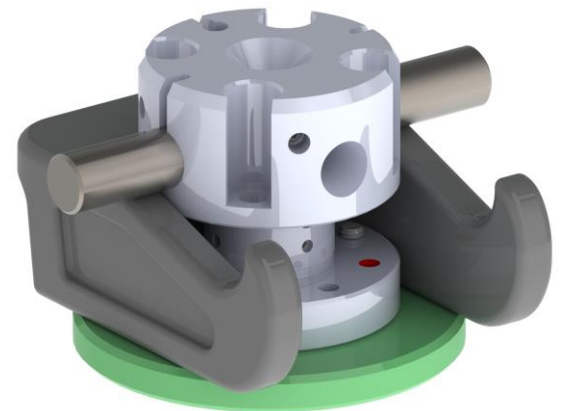
The DAC is versatile and can be used for x-ray diffraction with symmetric diffraction opening of $58^{\circ} \pm 4^{\circ}$ with BA anvils with conical support. The short working distance (~11-12 mm) also makes it convenient for optical studies, such as Raman spectroscopy and other spectroscopic techniques. It can be easily integrated with a compact "whole cell" resistive heater in water cooled enclosure when mild heating the sample to 200-300°C is required.

Usually handling small DACs is a little more difficult than larger DACs. To minimize this problem we supply the DAC with several attachments (detachable base, removable handles, and lever rocker tool) to simplify handling of the DAC.



Usually handling small DACs is a little more difficult than larger DACs. To minimize this problem we supply the DAC with several attachments (detachable base, removable handles, and lever rocker tool) to simplify handling of the DAC.

The DAC allows for multiple ways of pressure control. Typically the pressure in the DAC is controlled by four M4 screws – either two left (LH) and two right (RH), or all RH screws on request. Nevertheless the DAC can be easily integrated with single or double membrane BeCu or Steel canister (compression and decompression) and fit into 47 mm (all versions) and down to 59 mm (shortened version) cryostat bores along and perpendicular the bore axis respectively.





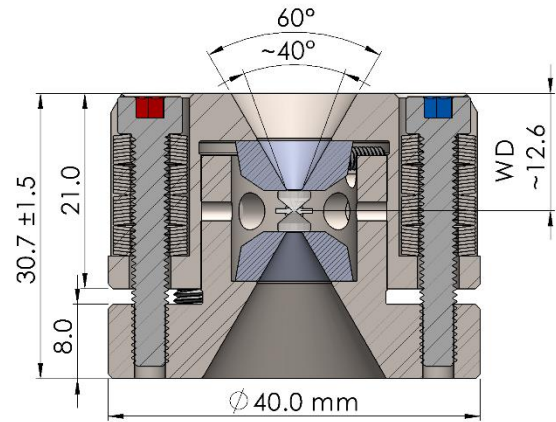
SPECIFICATIONS OF MINI SYMMETRIC 40 mm DIAMETER DIAMOND ANVIL CELL

Main DAC Specifications

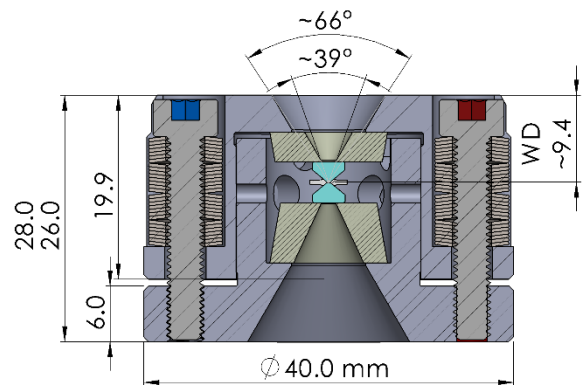
Material:	Hardened SS 440C BeCu C17200
Height:	~30.7 (27.5) ± 1.5 mm
Diameter:	40.0 mm
Working distance:	~12.6 (11.0) ± 1 mm
Mass:	~ 250 (220) g
Optical opening:	Up to 60 degrees
Diamond seats:	Tungsten carbide (typ.), Optional cBN, BeCu, and Pascalloy (Non-magnetic)
Pressure screws:	M4 x 25 (22) mm, 2x LH and 2x RH or 4x RH (model dependent)
Spring washers:	8.0 mm OD, 4.2 mm ID, 0.3-0.5 mm thick.
Diamond seat diameter:	12.5-13.0 mm (13.5 mm max)
Minimum height of two seats + two diamonds:	13.5 mm (13.0 mm)
Maximum experimental P:	>100 GPa

DAC Dimensions

Regular Version



Shortened Version



Related Equipment

Laser drilling systems



Ruby pressure systems



Membrane P Control



For more information please visit www.DACTools.com

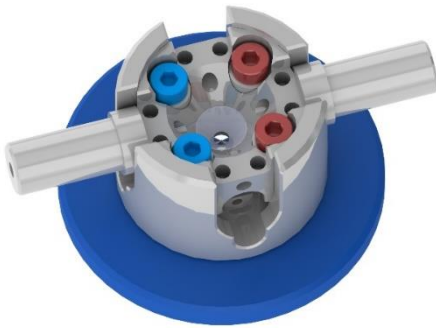


Mini-BX80 Diamond Anvil Cells (DAC)

Model Mini-BX80

The Mini-BX80 is a compact symmetric piston-cylinder type DAC with split piston and cylinder. It is an upgraded and optimized version of the Mini-BX90 DAC described in the paper: [BX90: A new diamond anvil cell design for X-ray diffraction and optical measurements by Kantor, I. et al. Rev. Sci. Instrum. 83, 125102 \(2012\).](#)

The main features of the Mini-BX80 DAC are compact size (OD = 39 mm), up to 80 degrees of symmetric X-ray opening (depending on diamonds and seats), short working distance, high stability and flexibility in accepting different diamond + seat combinations. These features make the Mini-BX80 DAC suitable for the whole range of techniques from optical spectroscopy (such as Raman and Brillouin) to single crystal X-ray diffraction and total scattering measurements. In particular the DAC is very suitable for double sided laser heating systems with short distance between optical elements of the laser heating systems (e.g. <42 mm between mirrors at 13-IDD station at GSECARS / APS), even in a special cryostat with remote membrane pressure control.



The DAC can be used with many diamond / seat combinations with total diamond + seat thickness from ~10 mm to ~15 mm. The typical combinations are 80 degrees conical Boehler-Almax (BA) diamond with 4.5 mm high seat, 70 degrees BA diamond with 5.5 mm seat and "Standard"/Drukker diamond with flat WC/cBN seat up to 5.3-6.0 mm high. The maximum symmetric X-ray angle of 80 degrees can be achieved with 4.5 mm high BA seats with 80 degrees BA diamonds. Modifications with larger openings, up to 115 degrees, are possible.

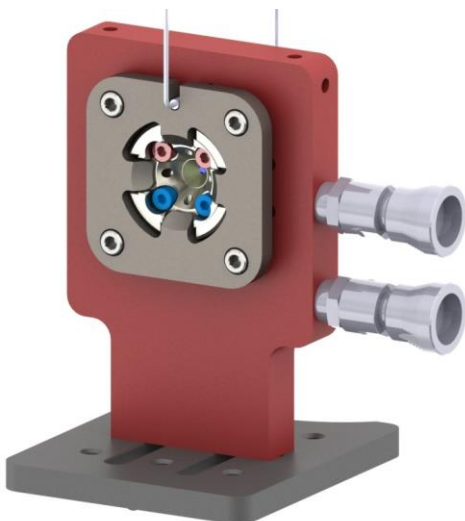
Please note that the DAC does not have a diamond tilt mechanism and thus it will only work properly if the diamond culets are parallel to the bases of the diamond seats. With proper diamond culet (<250 μm), diamond alignment, and sample preparation the DAC can be routinely used in sub-Megabar and Megabar pressure range.

The DAC can be readily loaded with compressed gas pressure transmitting medium (He, Ne, Ar, etc.) – appropriate gas loading gearboxes have been developed by DACTools for GSECARS, CIW, and Top Industrie types of high pressure gas loading systems.



The DACs allows for multiple ways of pressure control – either with screws, mechanical gearboxes, or with single or double membranes (see e.g. [Sinogeikin et al., Rev. Sci. Instruments 86, 072209, 2015](#)). The DAC can be preloaded to starting pressure with four M4 screws (typically two left-handed and two right-handed) and then engaged with remote pressure control device.

The DAC can be supplied as stand-alone version, with a single membrane enclosure (2.0" or 1.5" OD membrane) or double-membrane pressure frame both of which provide up to 80 degrees real symmetric X-ray and optical opening with proper choice of membranes (as well as diamonds and seats). Note that even with the membrane canister the working distance on each side of the DAC is less than 20 mm even when the total height of diamonds + seats is at maximum (15 mm).



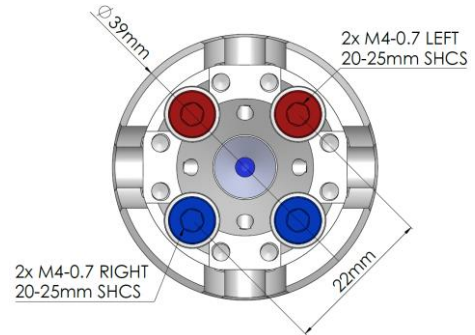


Specifications of Mini-BX80 Diamond Anvil Cells (DAC)

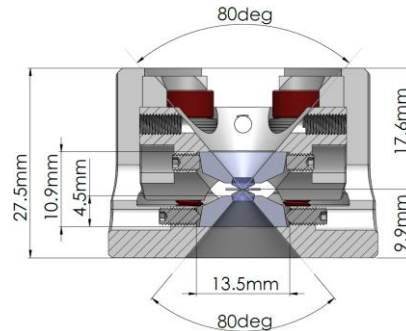
Main DAC Specifications

- Height: ~27.5 - 31.0mm
- Diameter: 39.0 mm
- Working distance: ~9.9-12.1 mm
- Mass: ~ 150 g
- Optical / top angle: 80° max.
- X-ray angle (max): 80° symmetric max.
- DAC material: *Stainless Steel 440C or Vascomax C300/C350 Tempered to HRc ~55*
- Seats: *BA60 Tungsten carbide (typ.), BA30 Vascomax, Flat WC and cBN*
- Screws: *M4, 2RH+2LH (all RH optional), 15-25 mm long.*
- Screw position: *4x 90° apart on 22 mm BCD*
- Spring washers: *8.0 mm OD, 4.2 mm ID, 0.4 mm thick (typical)*
- Diamond seat diameter: *12.5 – 13.0 mm (13.4 mm max)*
- Range of heights of two seats+diamonds: *10.2 – 15.0 mm*

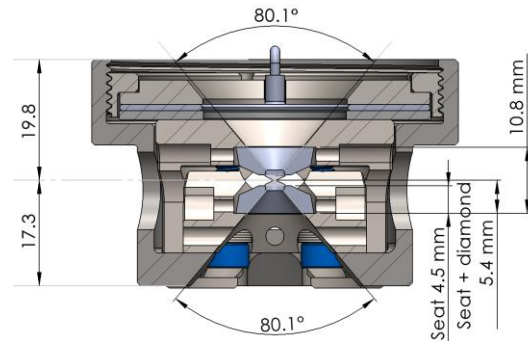
DAC Dimensions



BA 80° diamonds/seats

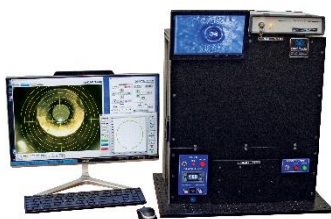


80 degrees diamonds, membrane can



Related Equipment

Laser drilling systems



Ruby pressure systems



Membrane P Control



For more information please visit <http://dactools.com/diamond-cells>



SSDAC-80 Diamond Anvil Cells (DAC) with symmetric 80° x-ray diffraction openings

Model SSDAC-80

The SSDAC-80 (Spherical Seat DAC with 80 degrees symmetric X-ray opening) is based on large symmetric opening SSDAC-70 (upgrade of an earlier BX-90 DAC), but has a different aspect ratio to allow up to 80 degrees symmetric X-ray opening. It was specifically designed for single crystal x-ray diffraction on a laboratory-based Rigaku diffractometer and for use with Böhler-Almax type conical seats where diamond tilt alignment can be crucial. The design allows the cell to be used with two membranes (compression and decompression) and still keep up to 80 degrees symmetric x-ray opening.

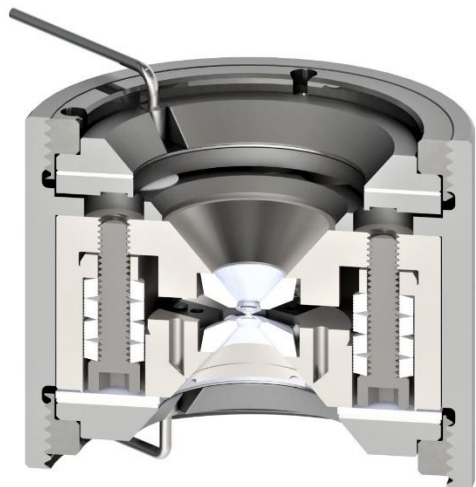
SSDAC-80 is a single crystal diffraction DAC, but it can be used with a variety of experimental techniques where large symmetric opening is required such as X-ray total scattering measurements, Brillouin and other optical spectroscopies as well as powder x-ray diffraction. The DAC can be provided with a detachable pin for mounting on a diffractometer goniometer. If 80 degrees symmetric opening is not absolutely crucial, a more stable 70 degrees configuration is recommended (SSDAC-70).

SSDAC-80 has the same diameter (although slightly different height) and hole pattern as iBX70 / iBX80 and SSDAC-70 DACs and is compatible with equipment designed for those DACs (DAC holders, membrane cans, gearboxes for gas-loading systems, etc.).

The DAC can be used with several diamond / seat combinations, but to make full use of the large symmetric opening the Böhler-Almax type diamond / seats with conical support are preferred. Because the diamond tilt in this DAC can be adjusted with a spherical seat base, the SSDAC is especially useful for cases where the diamond culets are not perfectly parallel to the bases of the diamond seats. The minimum 2x diamond + seat height for SSDAC-80 is ~10.5 mm.

With proper diamond culet size (<250 μm), diamond alignment, and sample preparation the DAC can be routinely used in sub-Megabar and Megabar pressure range.

The DACs allows for multiple ways of pressure control – either with screws, mechanical gearboxes, or with membranes (see e.g. Sinogeikin et al., *Rev. Sci. Instruments* 86, 072209, 2015). The DAC can be preloaded to starting pressure with four #8-32 screws and then engaged with remote pressure control device. The DAC can be supplied as stand-alone version, with one membrane enclosure, or in double-membrane symmetric configuration which provides up to 80 degrees symmetric X-ray and optical opening with proper choice of membranes.



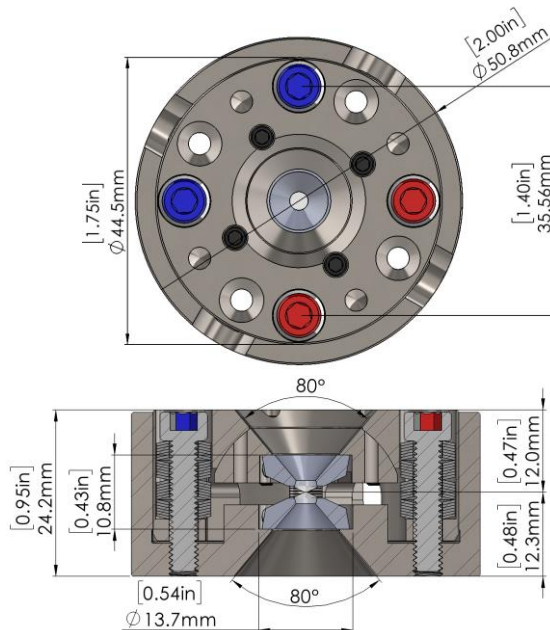


Specifications of SSDAC-80 Diamond Anvil Cell

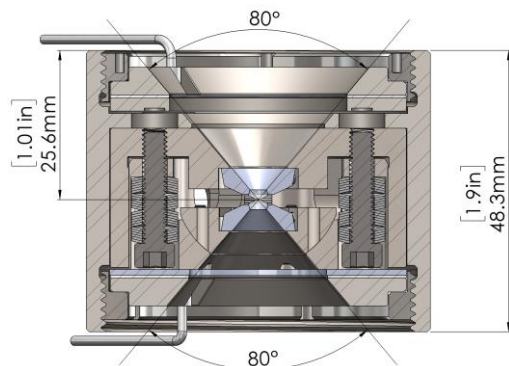
Main DAC Specifications

- Height: ~24.0-24.5 mm
- Diameter: 2.00" = 50.8 mm
- Working distance: ~12.0 / 12.5 mm
- Mass: ~ 280 g
- Optical / top angle: 80° max.
- X-ray angle (max): 80° symmetric
- DAC material: *Stainless Steel 440C or Vascomax C300/C350 Tempered to HRc ~55*
- Seats: *Tungsten carbide (typ.), Vascomax, cBN (optional)*
- Screws: *#8-32, 2RH+2LH (all RH optional) 0.750"- 0.875" long*
- Screw position: *4x 90° apart on 1.40" / 44.45mm BCD*
- Spring washers: *7.6-8.0 mm OD, 4.2 mm ID, 0.4 mm thick (typ.)*
- Diamond seat diameter: *12.5 – 13.0 mm (13.4 mm max)*
- Minimum height of two seats+diamonds: *10.5 mm*

DAC Dimensions



SSDAC-80 in 2 membrane can

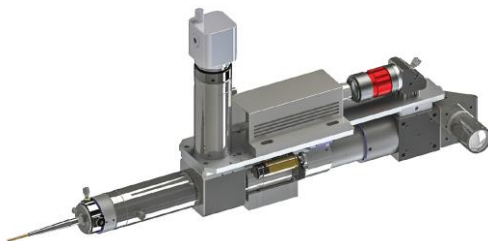


Related equipment

Pressure controllers



Ruby pressure systems



DAC Accessories



For more information please visit <http://dactools.com/diamond-cells>



11.28.2022



SSDAC-70 Diamond Anvil Cells (DAC) with symmetric 70° x-ray diffraction openings

Model SSDAC-70

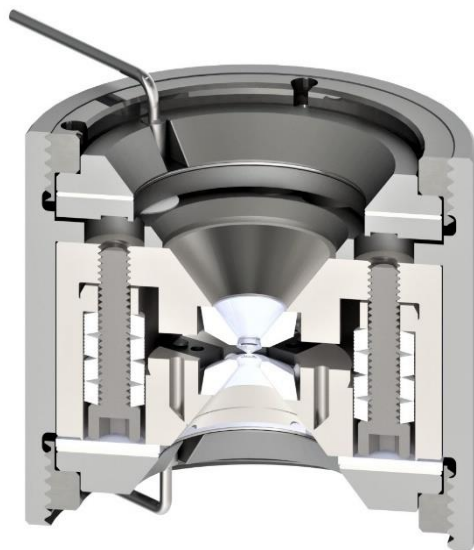
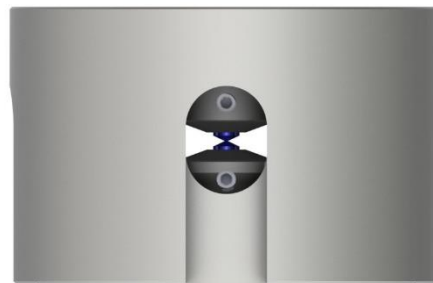
The **S**pherical **S**eat DAC (SSDAC-70) can be viewed as upgraded version of a popular large symmetric opening BX-90 DAC but equipped with a spherical rocker to simplify the alignment of diamond parallelness and optimized for effective use with double membrane pressure control systems. SS-DACs were specifically designed for single crystal X-ray diffraction and total scattering measurements, but can also be used for other techniques (such as Brillouin scattering) where large symmetric opening is required. Split pistons and cylinder designs make wiring of the internal part of the DAC very easy, and thus it is a DAC of choice for high temperature experiments with small resistive heaters as well as electrical resistivity measurements which require multiple wires inside the DAC close to the sample. Regular DACs are made of Stainless Steel 440C or Vascomax C300/350 while high temperature versions can be made from Inconel 718.

The DAC can be used with many diamond / seat combinations, but to make the full use of the large symmetric opening the Boehler-type diamonds and seats with 60 or 30 degrees conical support are preferred. Such diamonds and seats can be purchased either through DACTools, or from other suppliers. Because the diamond tilt in this DAC can be easily adjusted with a spherical seat base, the SSDAC is especially useful for cases where the diamond culets are not perfectly parallel to the bases of the diamond seats such as “classic” Boehler-Almax diamonds with 60° conical support and Tungsten Carbide seats.

SSDAC-70 has the same diameter (although slightly different height) and hole pattern as iBX70 / iBX80 and SSDAC-80 DACs and is generally compatible with equipment designed for those DACs (DAC holders, some membrane cans, gearboxes for gas-loading systems, etc.)

All SSDAC cells are Megabar-class DACs and with proper diamond culet size ($<250\ \mu\text{m}$), diamond alignment, and sample preparation the DAC can be routinely used in sub-Megabar and Megabar pressure range.

The SSDAC-70 allows for multiple ways of pressure control – either with screws, mechanical gearboxes, or with membranes (see e.g. Sinogeikin et al., *Rev. Sci. Instruments* 86, 072209, 2015). The DAC can be preloaded to starting pressure with four #8-32 screws and then engaged with remote pressure control device. The DAC can be supplied as stand-alone version, with one membrane enclosure, or in double-membrane symmetric configuration which provides up to 70 degrees symmetric X-ray and optical opening with proper choice of diamonds, seats, and membranes.



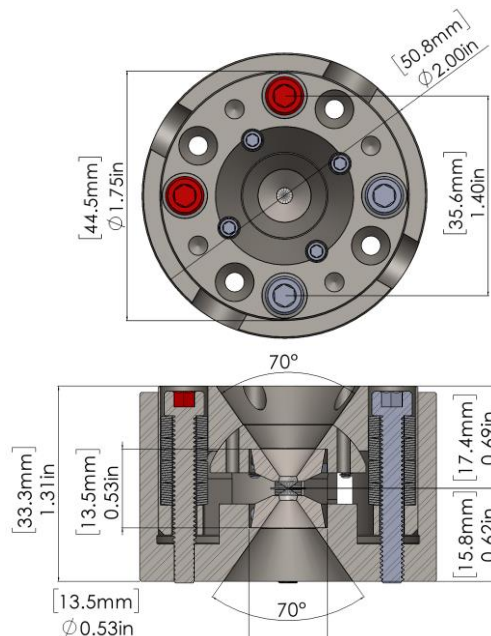


Specifications of SSDAC-70 Diamond Anvil Cell (DAC)

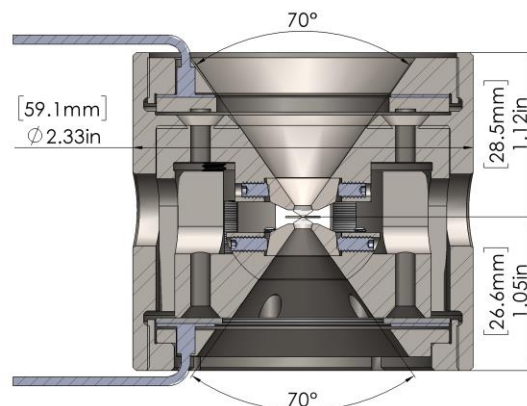
Main DAC Specifications

- Height: ~ 32-35 mm (Typ.)
- Diameter: 2.00" = 50.8 mm
- Working distance: ~16.0 / 18.0 mm
- Mass: ~ 330 g
- Optical / top angle: 70° max.
- X-ray angle (max): 70° symmetric
- DAC material: *Stainless Steel 440C or Vascomax C300/C350 Tempered to HRc ~55 Inconel 718 (Opt.)*
- Seats: *Tungsten carbide (typ.), Vascomax (opt.), cBN (opt.)*
- Screws: *#8-32, 2RH+2LH (all RH optional) 1.0" - 1.125" long*
- Screw position: *4x 90° apart on 1.40" / 44.45mm BCD*
- Spring washers: *7.6-8.0 mm OD, 4.2 mm ID, 0.4 mm thick (typ.)*
- Diamond seat diameter: *12.5 – 13.0 mm (13.4 mm max)*
- Minimum height of two seats+diamonds: *12.0-12.5 mm*

DAC Dimensions



SSDAC-70 in double membrane can

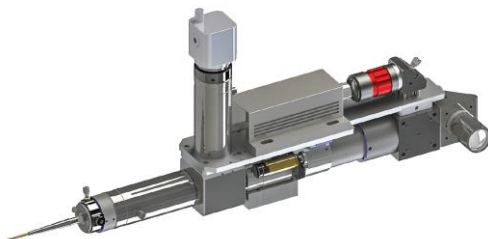


Related equipment

Pressure controllers



Ruby pressure systems



DAC Accessories



For more information please visit <http://dactools.com/diamond-cells>



11.28.2022



iBX70 / iBX80 Diamond Anvil Cells (DAC) with symmetric 70° / 80° x-ray diffraction openings

Models iBX70(L)-DAC and iBX80(L)-DAC

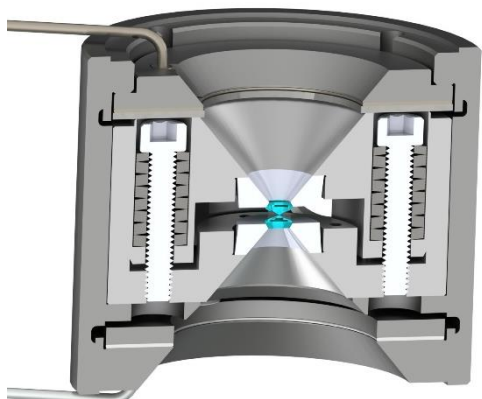
The iBX70 / iBX80 DACs are based on large symmetric opening Spherical Seat DACs (SSDAC70/80), but does not have a spherical rocker, which potentially results in easier handling and better stability. The iBX70 / iBX80 can be viewed as upgraded user-friendly and membrane-friendly versions of BX90 DAC with more symmetric configuration and better compatibility with external devices.

iBX70 / iBX80 DACs were specifically designed for single crystal X-ray diffraction and total scattering measurements, but can also be used with other techniques (such as Brillouin and other optical spectroscopies as well as powder x-ray diffraction) where large symmetric opening is required. The DAC can be provided with a detachable pin for mounting on a diffractometer goniometer. If 80 degrees symmetric opening is not absolutely crucial, a more stable 70 degrees configuration is recommended.

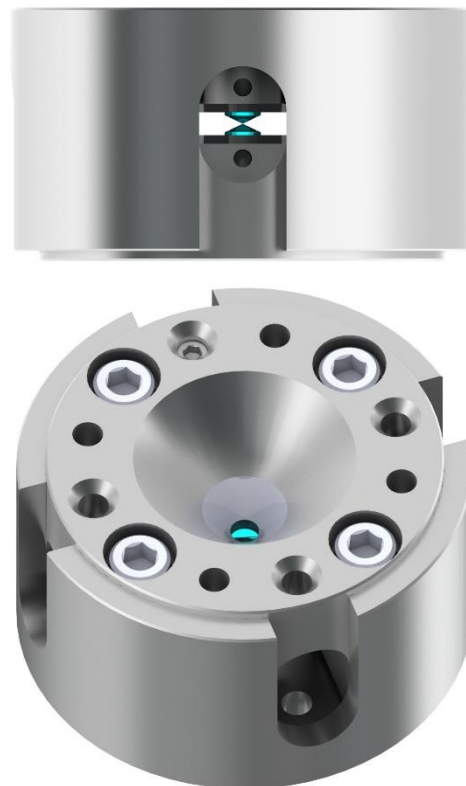
iBX70 / iBX80 DACs have the same diameter (although slightly different height) and hole pattern as DACTools' SSDAC70 / SSDAC80 cells and are compatible with equipment designed for those DACs (membrane cans, gearboxes for gas-loading systems, etc.). Typically the DACs come with two left-handed (LH) and two right-handed (RH) #8-32 pressurizing screws, although all RH versions can be available on demand.

The DAC can be used with many diamond / seat combinations, but to make full use of the large symmetric opening the Boehler-Almax type diamond / seats with conical support are preferred (assuming that the diamond is properly aligned with respect to the seat base). Please note that the DAC will only work properly if the diamond culets are parallel to the bases of the diamond seats. The minimum 2x diamond + seat height is 11.5 mm for SSDAC70 and 10.5 mm for SSDAC80).

With proper diamond culet (<250 μm), diamond alignment, and sample preparation the DAC can be routinely used in sub-Megabar and Megabar pressure range.



The DACs allows for multiple ways of pressure control – either with screws, mechanical gearboxes, or with membranes (see e.g. *Sinogeikin et al., Rev. Sci. Instruments 86, 072209, 2015*). The DAC can be preloaded to starting pressure with four #8-32 screws and then engaged with remote pressure control device. The DAC can be supplied as stand-alone version, with one membrane enclosure, or in double-membrane symmetric configuration which provides up to 70 or 80 degrees symmetric X-ray and optical opening with proper choice of membranes.



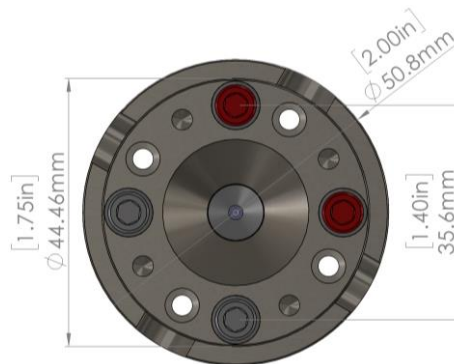


Specifications of iBX70 / iBX80 Diamond Anvil Cells (DAC)

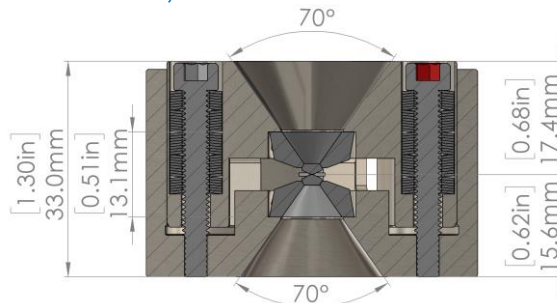
Main DAC Specifications (iBX70 / iBX80)

- Height: ~33.0 / 27.6 mm
- Diameter: 2.00" = 50.8 mm
- Working distance: ~15.6 / 12.6 mm
- Mass: ~ 350 / 290 g
- Optical / top angle: 70° / 80° max.
- X-ray angle (max): 70° / 80° symmetric
- DAC material: *Stainless Steel 440C or Vascomax C300/C350 Tempered to HRc ~55*
- Seats: *Tungsten carbide (typ.), Vascomax, cBN (optional)*
- Screws: *#8-32, 2RH+2LH (all RH optional) 1.125 / 0.875" long*
- Screw position: *4x 90° apart on 1.40" BCD*
- Spring washers: *8.0 mm OD, 4.2 mm ID, 0.4 mm thick (typical)*
- Diamond seat diameter: *12.5 – 13.0 mm (13.4 mm max)*
- Minimum height of two seats+diamonds: *12.0 / 10.5 mm*

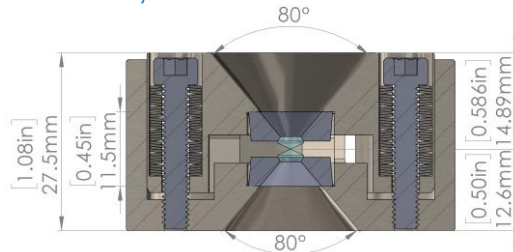
DAC Dimensions



iBX70, BA 70° diamonds/seats



iBX80, BA 80° diamonds/seats



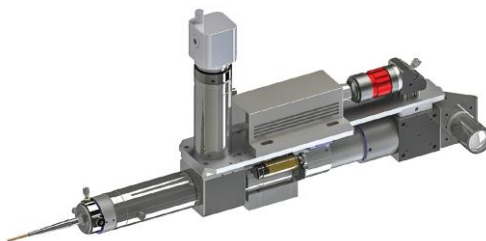
NOTE: The Actual height of the DACs can slightly vary in different models

Related equipment

Pressure controllers



Ruby pressure systems



DAC Accessories



For more information please visit <http://dactools.com/diamond-cells>



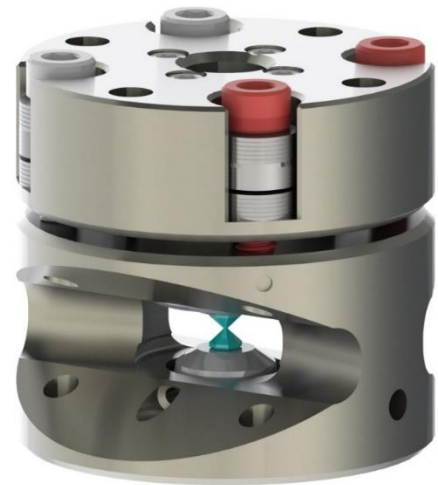
11.28.2022

Compact Panoramic 2-fold Diamond Anvil Cell for x-ray tomography with 150 degrees side view

Model TOMO150-1875-(SS440C)-DAC

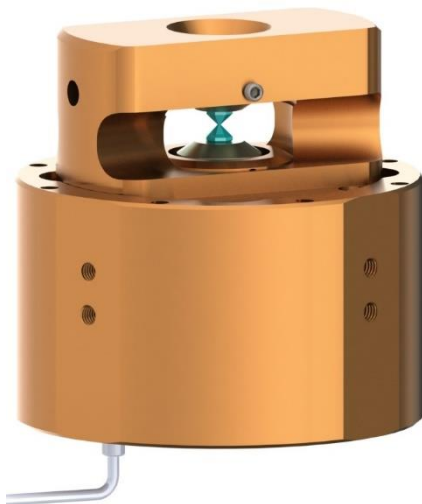
DACTools offers a variety of static and dynamic Panoramic Diamond Anvil Cells (DACs) for radial x-ray diffraction measurements, X-ray tomography, inelastic X-ray scattering measurements with or without polycapillary optics, NRIXS measurement with large APD detectors, and other techniques requiring large angle panoramic view in radial geometry and easy access to the sample.

TOMO150 compact panoramic 2-fold Diamond Anvil Cell was primarily designed for x-ray tomography – it provides 150 degrees of unobstructed symmetric radial opening in horizontal direction and up to 50 degrees in vertical direction (depending on the diamond + seat configuration).



The TOMO150 DAC is based on the same frame as the GL-CIW type Imperial Standard Symmetric DAC: 1.875 inch Outside diameter and two left handed (LH) and two right handed (RH) #10-32 pressurizing screws on 1.5 inch (38.1 mm) Bolt Circle Diameter. This makes integration of this DAC into experimental infrastructure (DAC holders, gearboxes, membrane systems, etc.) developed for Symmetric DACs relatively easy and straightforward. The DAC is suitable for variety of experimental techniques such as X-ray diffraction in radial and axial scattering geometry, inelastic X-ray scattering, X-ray tomography, various time-resolved experiments, as well as optical measurements such as Raman spectroscopy among others. With proper diamond culet size (<250 μm), diamond parallelness and alignment, and proper sample preparation, the DAC can readily reach and exceed megabar pressures. If hydrostatic conditions are required – the DAC can be loaded with inert gases as pressure medium in GSECARS / APS type and compatible gas loading systems.

The panoramic DAC is typically made of Stainless Steel 440C or Vascomax C-300/350 superalloy hardened and tempered to HRc 56-58 for optimal properties. The piston can be coated with a layer of chrome on demand, or the whole DAC can be coated with MoS_2 for better lubricity and protection from elements. Cryogenic BeCu versions with easily are under development.



The DAC allows for multiple ways of pressure control. Typically the pressure in the DAC controlled by four #10-32 screws. The DAC can be easily integrated with single or double membrane drive or piezo-electric pressure control systems for remote pressure control and time-resolved experiments. A slightly modified version of the DAC for easier single-membrane canister integration can be provided on special request. Some examples of application of a similar DAC are described in [Sinogeikin et al., Rev. Sci. Instruments 86, 072209, 2015.](#)

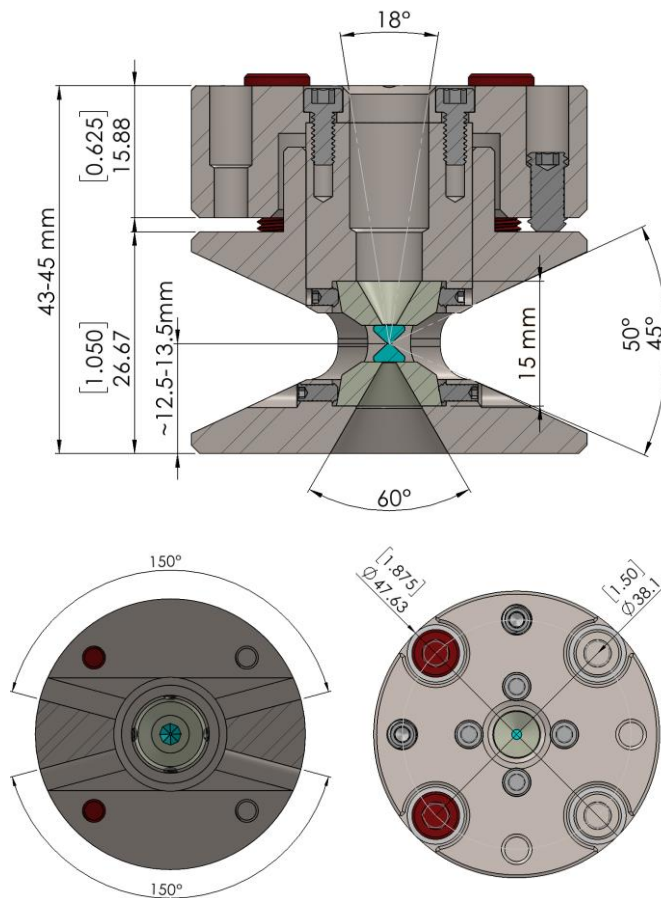
Specifications of Compact Panoramic 2-fold Diamond Anvil Cell with 150 degrees side view

Main DAC Specifications

- Height: ~1.7-1.8 inch (43-45 mm)
- Diameter @ base: 1.875" (47.63 mm)
- Working distance: ~13 mm
- Mass: ~ 410 g
- Optical angles (N.A.): 60 degrees (0.5)
- Axial X-ray opening: ~18-60 degrees
- Hor. Side openings: ~150 degrees
- Ver. Side openings: ~45-50 degrees
- Seats: Tungsten carbide (typ.), cBN optional
- Screws: 10-32 x ~1.0" (vary), 2 LEFT + 2 RIGHT on 1.50" BCD
- Spring washers: 0.375" OD, 0.190" ID, 0.015-0.020" thick
- Diamond seat diameter: ~0.5" (12.5-13.0 mm)
Max 0.52" (13.4 mm)
- Minimum height of two seat + diamonds: 0.53" (13.4 mm)
- Maximum pressure: > 100 GPa with proper diamonds and alignment

DAC Material Properties

- Type: Stainless 440C or Vascomax C300/350
- Magnetic?: Yes

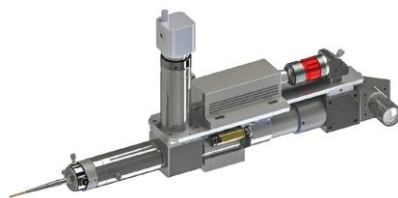


Related equipment

Pressure controllers



Ruby pressure systems



DAC Accessories



For more information please visit www.DACTools.com



11.28.2022

Compact Panoramic 4-fold Diamond Anvil Cell with 60 degrees side openings optimized for NRIXS

Model PanDAC-4F-60D-NRIXS

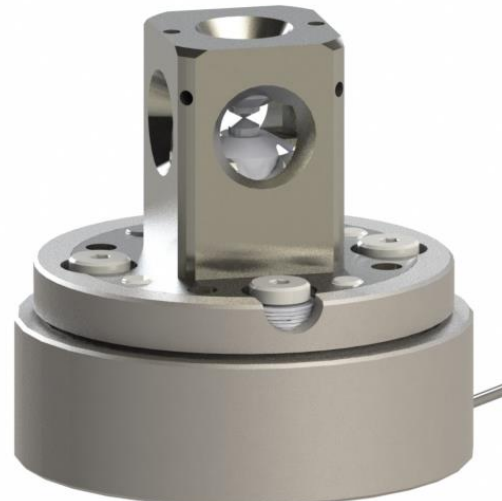
DAC Tools offers a variety of compact piston-cylinder type Diamond Anvil Cells (DACs) suitable for variety of experimental techniques such as X-ray diffraction in radial and axial scattering geometry, inelastic X-ray scattering, X-ray tomography, various time-resolved experiments with pneumatic and piezo pressure control, electric measurements, as well as optical measurements such as Raman spectroscopy among others. With proper diamond culet size ($<250\ \mu\text{m}$), diamond parallelness and alignment, and proper sample preparation, the DAC can readily reach and exceed megabar pressures. If hydrostatic conditions are required – the DAC can be loaded with inert gases as pressure medium in GSECARS / APS type and compatible gas loading systems.



The four-fold panoramic DAC offers four side cones at 90° offering 63° - 64° of side opening for radial diffraction, tomography, of x-ray spectroscopy. The X-ray diffraction opening in axial direction depends on the diamond/seat combination and is typically ~ 30 - 40 degrees with WC seats with 1.1-1.65 mm opening and up to 60 degrees with cBN seats. For optical measurements the effective working distance is about 11 mm with numerical aperture of 0.5.

The panoramic DAC is typically made of Stainless Steel 440C or Vascomax C-300/350 superalloy hardened and tempered to HRc 56-58 for optimal properties. The piston can be coated with a layer of chrome on demand, or the whole DAC can be coated with MoS_2 for better lubricity and protection from elements. The DAC can be used at both cryogenic conditions, as well as to high temperatures with resistive heating (with special setups and environments).

The DAC allows for multiple ways of pressure control. Typically the pressure in the DAC controlled by four 10-32 screws from either side depending on experimental setup. The design of the DAC allows for use of decompression springs which can be engaged before or during the experiment. The DAC can be easily integrated with single membrane or piezo-electric pressure control systems for remote pressure control and time-resolved experiments. Some examples of application of a similar DAC are described in Sinogeikin et al., *Rev. Sci. Instruments* **86**, 072209, 2015.



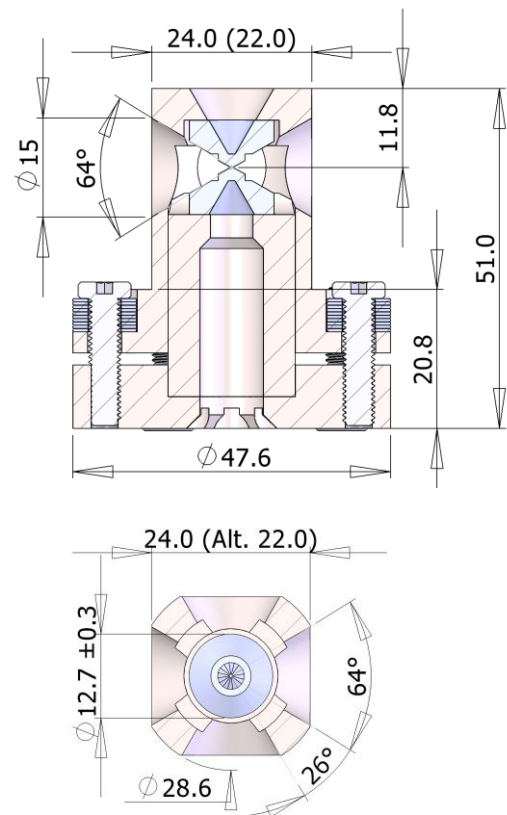
Specifications of Compact Panoramic 4-fold Diamond Anvil Cell with 60 degrees side openings

Main DAC Specifications

Height:	~2.01" (~51 mm)
Diameter @ base:	1.875" (47.63 mm)
Diameter @ top:	1.10" (27.9 mm)
Working distance:	~11.8 mm
Mass:	~ 320 g
Optical angles (N.A.):	60 degrees (0.5)
Axial X-ray opening:	~28-60 degrees
Side openings (4x):	~63-64 degrees
Seats:	Tungsten carbide (typ.), cBN optional
Screws:	10-32 x ~1.0" (vary), All right-handed
Spring washers:	0.375" OD, 0.190" ID, 0.015-0.020" thick
Diamond seat diameter:	~0.5" (12.5-13.0 mm) Max 0.52" (13.4 mm)
Minimum height of two seat + diamonds:	0.49" (12.5 mm)
Maximum pressure:	> 100 GPa with proper diamonds and alignment

DAC Material Properties

Material::	Stainless 440C or Vascomax C300/350
Ultimate strength:	1750-2400 MPa (typ)
Yield strength (0.2%):	1280-2340 MPa (typ)
Magnetic?:	Yes

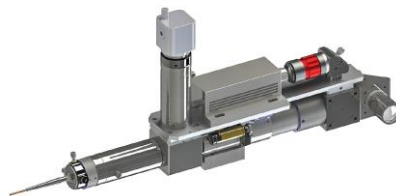


Related equipment

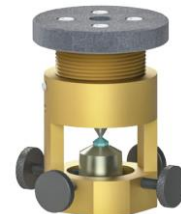
Pressure controllers



Ruby pressure systems



DAC Accessories



For more information please visit www.DACTools.com



06.03.2020

Compact Panoramic 2-fold and 4-fold Diamond Anvil Cell with 80+ and 60+ degrees side openings

Models PanDAC-2F-80D and PanDAC-4F-60D(-NRIXS)

DAC Tools offers a variety of compact piston-cylinder type Diamond Anvil Cells (DACs) suitable for variety of experimental techniques such as X-ray diffraction in radial and axial scattering geometry, inelastic X-ray scattering, X-ray tomography, various time-resolved experiments with pneumatic and piezo pressure control, electric measurements, as well as optical measurements such as Raman spectroscopy among others. With proper diamond culet size ($<250\ \mu\text{m}$), diamond parallelness and alignment, and proper sample preparation, the DAC can readily reach and exceed megabar pressures. If hydrostatic conditions are required – the DAC can be loaded with inert gases as pressure medium in GSECARS / APS type and compatible gas loading systems.



Our compact panoramic DAC comes in several modifications – 2-fold with round but cut on top cylinder and 4-fold with round or squared cylinder (for NRIXS measurements with down to 11 mm APD detector to sample distance). The two-fold DAC offers up to 85° opening in horizontal direction (sample plane) and up to 81° opening in vertical (with undercut seats) 180° apart. The four-fold panoramic DAC offers four side cones with $\sim 63^\circ - 64^\circ$ degrees opening at 90° apart. The X-ray diffraction opening in axial direction depends on the diamond/seat combination and is typically $\sim 30-40$ degrees with WC seats with 1.1-1.65 mm opening and up to 60 degrees with cBN or conical support seats. For optical measurements the effective working distance is about 11-12 mm with numerical aperture of up to 0.5.

The panoramic DAC is typically made of Stainless Steel 440C or Vascomax C-300/350 superalloy hardened and tempered to HRC 56-58 for optimal properties. The DACs can also be made from more exotic materials such as Beryllium Copper or Silicone Bronze. The piston can be coated with a layer of chrome on demand, or the whole DAC can be coated with MoS_2 for better lubricity and protection from elements. The DAC can be used at both cryogenic conditions and high temperatures with resistive heating (with special setups and environments).

The DAC allows for multiple ways of pressure control. Typically the pressure in the DAC is controlled by four #10-32 screws from either side depending on experimental setup. The design of the DAC allows for use of decompression springs which can be engaged before or during the experiment. The DAC can be easily integrated with single membrane or piezo-electric pressure control systems for remote pressure control and time-resolved experiments. Some examples of application of a similar DAC are described in *Sinogeikin et al., Rev. Sci. Instruments* **86**, 072209, 2015.



Specifications of Compact Panoramic 4-fold Diamond Anvil Cell with 60 degrees side openings

Main DAC Specifications

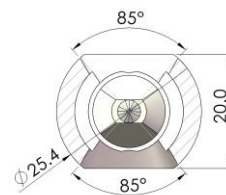
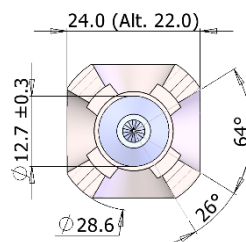
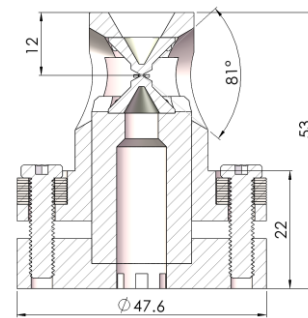
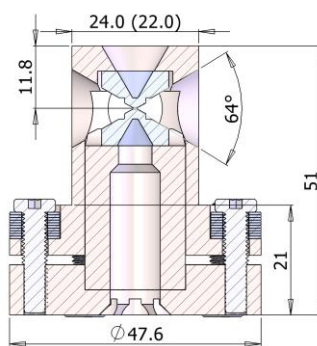
- Height: ~2.0" (~51-53 mm)
- Diameter @ base: 1.875" (47.63 mm)
- Diameter @ top: 1.0"-1.125" (25.4 - 27.9 mm)
- Working distance: ~11.8 mm – 12.0 mm
- Mass: ~ 320 g
- Optical angles (N.A.): 60 degrees (0.5)
- Axial X-ray opening: ~28-60 degrees
- Side openings: ~63-64 degrees (4x)
~80-85 degrees (2x)
- Seats: Tungsten carbide (typ.), cBN optional
- Screws: 10-32 x ~1.0" (vary), All right-handed
- Spring washers: 0.375" OD, 0.190" ID, 0.015-0.020" thick
- Diamond seat diameter: ~0.5" (12.5-13.0 mm)
Max 0.52" (13.4 mm)
- Minimum height of two seat + diamonds: 0.49" (12.5 mm)
- Maximum pressure: > 100 GPa with proper diamonds and alignment

DAC Material Properties

- Material: Stainless 440C or Vascomax C300/350
- Ultimate strength: 1750-2400 MPa (typ)
- Yield strength (0.2%): 1280-2340 MPa (typ)
- Magnetic?: Yes

A. 4-fold Pan DAC with up to 64 x 64 degrees openings at 90 degrees

B. 2-fold Pan DAC with up to 85 x 81 degrees openings 180° apart



Related equipment

Pressure controllers



Ruby pressure systems



DAC Accessories



For more information please visit www.DACTools.com



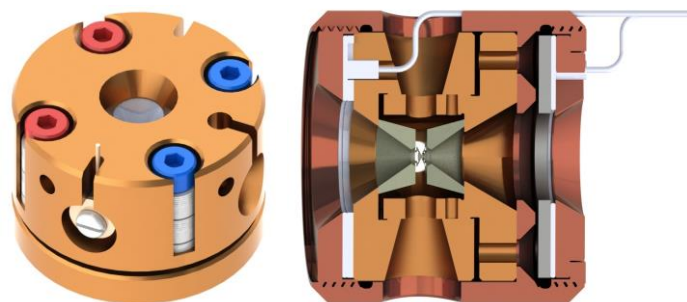
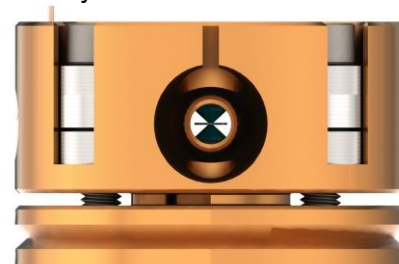
11.28.2022



LARGE OPENING CRYOGENIC BeCu DACs

A large number of physical phenomena, such as superconductivity, magnetic ordering, quantum critical phenomena, and others often appear only at extremely low cryogenic temperatures (e.g. below 5-10 K). Therefore there is a lot of interest in studying various materials at simultaneously low temperature and high pressure by different experimental methods and thus a significant demand for a variety of different diamond cells designed for low temperature studies. While DACs made of hard steel (SS 440C, Vascomax C300/350, etc.) can be used in low temperature experiments, especially in “wet” cryostats, the material of choice for cryogenic DACs is Beryllium Copper alloy (e.g. C17200 / Alloy 25) which has a unique combination of properties: non-magnetic, high strength, high thermal conductivity.

Currently our most popular BeCu DAC is Shortened Symmetric DAC. It is based on a Metric Symmetric DAC (48 mm OD) but with cylinder shortened by 5 mm to decrease working distance (for e.g. Raman spectroscopy) to ~12 mm and reduce thermal mass. The DAC can be easily integrated into a number of cold-finger cryostat and has built-in features such as socket for mounting temperature sensor in CU package, holes and threads for bolting the DAC to cold finger base, and so on.



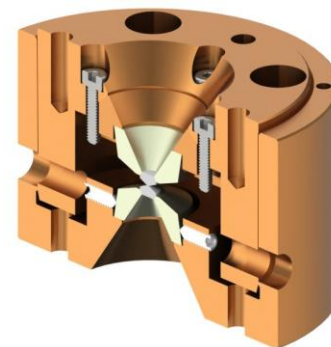
Another modification of the Standard Symmetric DAC is a Mini-Symmetric DAC with 40 mm Diameter. This DAC has smaller outside dimensions and is ~50% lighter than the full sized BeCu DAC. Nevertheless, the inner diameter and height of the diamond / seat area is the same and allows using “standard” sized diamond anvils and seats.

The DAC can be easily integrated with single or double membrane BeCu canister (compression and decompression) and fit into 47 mm (all versions) and <59 mm (shortened version) cryostat bores along and normal to the bore axis respectively.

Another large opening cryogenic DAC recently developed by DACTools has 70 degrees symmetric opening and diamond tilt mechanism so that the DAC can be easily used with Boehler-Almax type diamond anvils and seats. The DAC was initially developed as a part of cryogenic system for single crystal Brillouin scattering (can continuously rotate about the DAC axis inside the cryostat) but can be used for a variety of other studies such as single crystal x-ray diffraction.

Virtually any type of DACTools’ DACs (e.g. split-style SSDAC 70/80 and Mini-BX80, BX-60/70/80, or custom DACs) can be made of BeCu alloy providing that there is sufficient demand (e.g. 4-5 DACS) to justify production.

If the DACs are intended to be used in strong magnetic fields, they can be supplied with non-magnetic screws (e.g. BeCu, Inconel 718, Titanium5) and spring washers (Inconel 718) or split cylinder springs (BeCu), as well as non-magnetic diamond seats made of either WC with Ni binder, BeCu, Pascalloy (non-magnetic NiCrAl alloy) or cemented cubic boron nitride.



To minimize tear and wear and improve the performance, stability and lifetime of BeCu DACs the pistons can be coated with Hard Chrome (magnetic) or the whole DAC can be coated with a layer of WS₂.

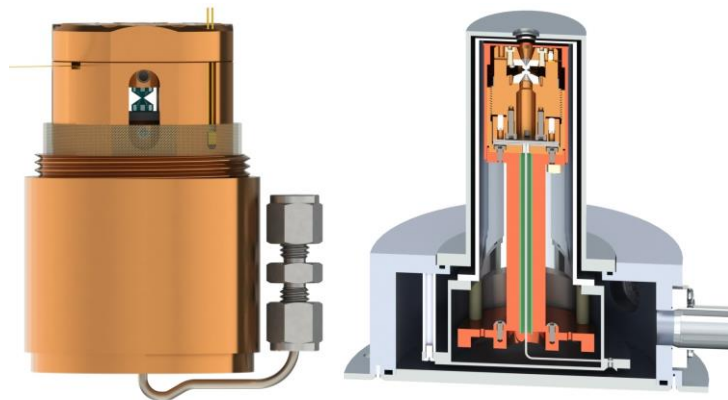
The variety of BeCu DACs and special diamond seats stocked by DACTools is constantly increasing – please contact us to check for available new models and lead times.



PANORAMIC AND SPECIALIZED BeCu DACS

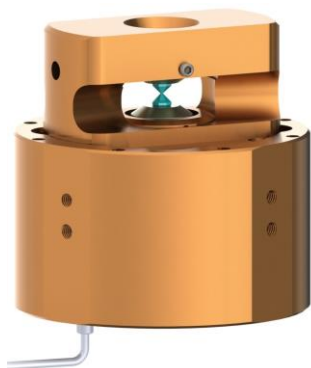
While large opening DACs can be used for a variety of experiments – X-ray scattering, optical spectroscopy, electric measurements and such, often they are not suitable for specific environments either because of limited geometry / opening or large size not appropriate for certain types of cryostats or experimental setups and conditions. Below are few examples of such DACs which have been designed and manufactured by DACTools.

The compact (38 mm OD, ~56 mm long) BeCu DAC with diamond tilt alignment rocker and integrated membrane pressure control was designed as nonmagnetic DAC for use with Janis ST-500 or Physike Scryo-S500 cryostats and strong magnetic fields (superconducting magnets with small bores) for Raman and other spectroscopy measurements requiring short working distance (WD \leq 12mm). The current version was designed for use with “blind” membrane thus the sample can be accessed optically from only top / cylinder side.



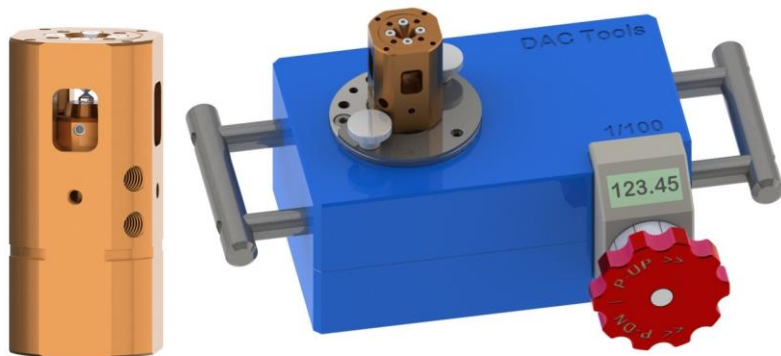
The DAC was initially designed to have an integrated membrane pressure control. Nevertheless it can be loaded and operated independently of the membrane. The DAC can be closed and pressure can be controlled with 4x M4 screws and a set of Belleville spring washers.

The Beryllium Copper version of DACTools TOMO150 DAC can be used in a variety of primarily x-ray based experiments where large (150 degrees) opening in the sample plane (perpendicular to DAC axis) is essential. It can be used in different X-ray spectroscopy / inelastic scattering measurements where the x-ray beam can be focused on the sample either through the diamond anvil or through the gasket, and the signal can be collected typically from a side through the x-ray transparent gasket. The DAC can also be used in a regular axial geometry although the angular opening is limited. The DAC can be easily integrated with a special membrane drive and radiation shield for improved temperatures.



The non-magnetic DT-25/28-55-BeCu DAC is designed for a variety of experiments at cryogenic conditions in confined spaces (28 mm min. diameter of the cryostat bore). The DAC is comparable with HMD PPMS 25 mm DAC (DAC-SRr-25-55) while has a lot of modifications to improve performance, stability, reliability, and ease of operations. The DAC has a rocker / spherical seat so that the tilt of one diamond anvil can be easily adjusted.

The pressure in the DAC is increased by rotating one pressurizing screw (1 mm pitch) with integrated ceramic thrust ball bearings. The pressure in the DAC is typically increased with an optional 100X gearbox (which can provide piston / pressurizing screw advancement with 100 nm = 0.1 μ m resolution), although other options including membranes) are possible.





BeCu Shortened Symmetric Diamond Anvil Cell Metric version (48 mm) Model BeCu-SYM48-WD12

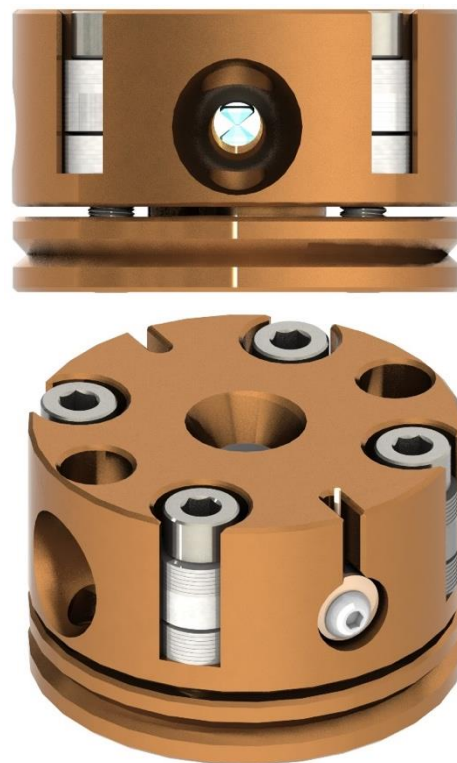
The Symmetric Diamond Anvil Cell (DAC) is perhaps the most popular DAC in the World. It is compact, versatile, simple to operate, user-friendly, and is easily adaptable to multiple experimental environments. The Symmetric DAC can be used for a multitude of laboratory-based optical spectroscopies (e.g. Raman, Brillouin, etc.), as well as X-ray diffraction, inelastic X-ray scattering, and a large variety of different experimental techniques. With proper diamond culet size ($<250\ \mu\text{m}$), diamond parallelness and alignment, and proper sample preparation, the DAC can readily reach megabar pressures ($>100\ \text{GPa}$).

The symmetric DACs are typically made of Vascomax or Stainless Steel 440C alloys, which are strong, but are magnetic and have low thermal conductivity limiting the use of such DACs in cold-finger type cryostats and measurements in strong magnetic fields. DACTools offers the Shortened Symmetric DAC made of BeCu alloy (C17200 / Alloy 25) with full-hard HT04 temper. To increase lifetime and decrease wear the DAC piston can be coated on request with a layer of hard chrome. The combination of the extremely high strength of the cell material and excellent thermal conductivity makes it optimal for use in cold-finger type cryostats, such as Physike Technology Scryo-S500 cryostat. Moreover, the design of the DAC allows to bolt the DAC piston directly to the cryostat cold finger, thus minimizing thermal losses, and conveniently attach temperature sensors, such as DT-670 in CU package, onto the DAC body close to the sample.

Beryllium-copper is a non-magnetic alloy and the DAC can be used in applications which require non-magnetic DACs. For such applications the DAC can be supplied with non-magnetic screws (e.g. Inconel and Ti5) and spring washers (Inconel or Beryllium Copper), as well as non-magnetic diamond seats made of either Pascalloy (non-magnetic NiCrAl alloy) or boron nitride.

While the DAC can be used for x-ray diffraction and other experiments, the shortened model is optimized for optical studies, such as Raman spectroscopy and other spectroscopic techniques requiring very small working distance: this DAC has a working distance of $\sim 12\ \text{mm}$ (5 mm shorter than a regular symmetric DAC) which allows to use short working distance ($<20\ \text{mm}$) optical objective even when the DAC is inside the cryostat.

The DAC allows for multiple ways of pressure control. Typically the pressure in the DAC is controlled by four M5 screws – two left and two right (to minimize relative rotation of the diamonds during pressure increase). Nevertheless the DAC can be easily integrated with standard and custom pressure control systems such as single or double membrane (compression and decompression), as well as piezo drive and mechanical (gearbox), which can be provided by DACTools.



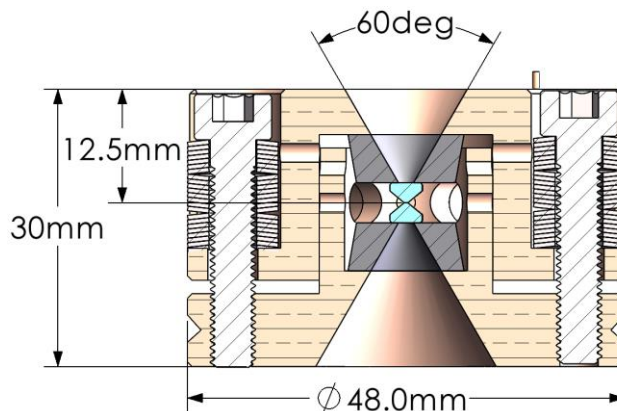
Specifications of BeCu Metric (48 mm) Shortened Symmetric Diamond Anvil Cell

Main DAC Specifications

Height:	~30 mm
Diameter:	48 mm
Working distance:	~12 mm
Mass:	~ 360 g
Optical opening:	Up to 60 degrees
Diamond seats:	Tungsten carbide (typ.), Optional Pascalloy and cBN (Non-magnetic)
Pressure screws:	M5 x 25 mm, 2x left and 2x right
Spring washers:	10.0 mm OD, 5.2 mm ID, 0.5 mm thick typ.
Diamond seat diameter:	12.5-13.0 mm (13.5 mm max)
Minimum height of two seat + diamonds:	13.5 mm
Maximum pressure:	>100 GPa

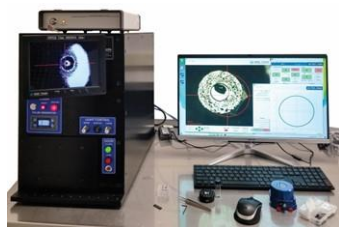
BeCu Material Properties

Type:	C17200 / Alloy 25
Temper:	HT04
Density:	8.25 g/cc
Ultimate strength:	1380 MPa (typ)
Yield strength (0.2%):	1240 MPa (typ)
Hardness Rockwell C:	38-42 (typ)
Thermal expansion (0°C):	~16.0 $\mu\text{m}/\text{m}\cdot^\circ\text{C}$
Specific Heat Capacity:	0.420 J/g $\cdot^\circ\text{C}$
Thermal conductivity (20°C):	105-130 W/m-K

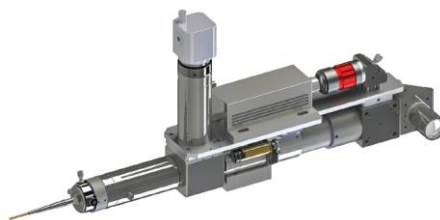


Related equipment

Laser drilling systems



Ruby pressure systems



Membrane P Control



For more information please visit www.DACTools.com



Dec. 2023



BeCu Mini Symmetric (40mm) Diamond Anvil Cell Model BeCu-40mm-Mini-SYMM-DAC-LR(/RR)-REG(/SHORT)

The Symmetric Diamond Anvil Cell (DAC) is perhaps the most popular DAC in the World. It is compact, versatile, simple to operate, user-friendly, easily adaptable to multiple experimental environments and can be used for a multitude of optical and X-ray studies and a large variety of different experimental techniques. With proper diamonds, alignment and sample preparation the DAC can readily reach megabar pressures (>100 GPa).

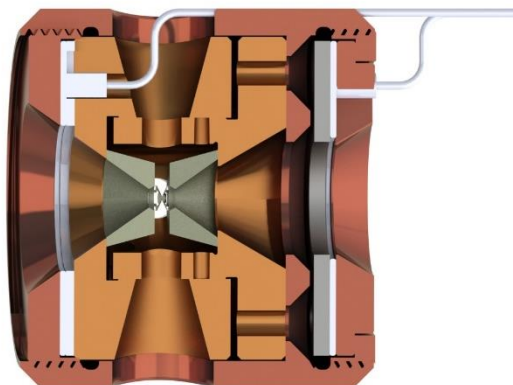
Mini Symmetric (40 mm) DAC is a direct derivative of the classic 1.875" / 48 mm symmetric DAC where unnecessary outside material was removed making it about 5 mm shorter (9 mm for shortened version) and ~8 mm smaller in diameter, thus reducing the mass of the DAC by ~50%. At the same time the inner diameter and height of the piston remain about the same as in classic symmetric DACs allowing to use standard size diamond seats and anvils.

This DAC was designed for cryogenic work, with possibility of using it in strong magnetic fields, and therefore is made of non-magnetic BeCu alloy (C17200 / Alloy 25) with full-hard HT04 temper. For such applications the DAC can be supplied with non-magnetic screws (e.g. BeCu, Inconel, Titanium5) and spring washers (Inconel), as well as non-magnetic diamond seats made of either BeCu, Pascalloy (non-magnetic NiCrAl alloy) or boron nitride.

To increase lifetime and decrease wear the DAC piston can be coated on request with a layer of hard chrome, or the whole DAC can be coated with a protective slippery layer of WS₂.

The combination of the extremely high strength of the cell material and excellent thermal conductivity makes it optimal for use in cold-finger type cryostats, for example Physike Technology Scryo S-500 / S-300 cryostats. The design of the DAC allows to conveniently attach temperature sensors, such as DT-670 in CU package, onto the DAC body close to the sample.

The DAC is versatile and can be used for x-ray diffraction with symmetric diffraction opening of $58^{\circ} \pm 4^{\circ}$ with BA anvils with conical support. The short working distance (~12 mm / 11 mm for shortened version) also makes it convenient for optical studies, such as Raman spectroscopy and other spectroscopic techniques.



The DAC allows for multiple ways of pressure control. Typically the pressure in the DAC is controlled by four M4 screws – either two left (LH) and two right (RH) to minimize relative rotation of the diamonds during pressure increase, or all RH screws on request. Nevertheless the DAC can be easily integrated with single or double membrane BeCu canister (compression and decompression) and fit into 47 mm (all versions) and down to 61 mm (shortened version) cryostat bores along and perpendicular the bore axis respectively.





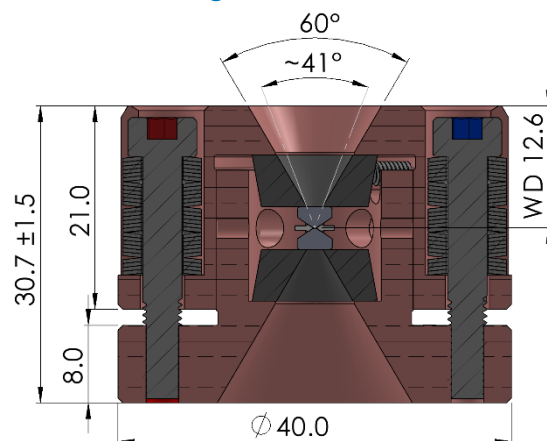
Specifications of BeCu Mini Symmetric DAC 40 mm Diameter Diamond Anvil Cell

Main DAC Specifications

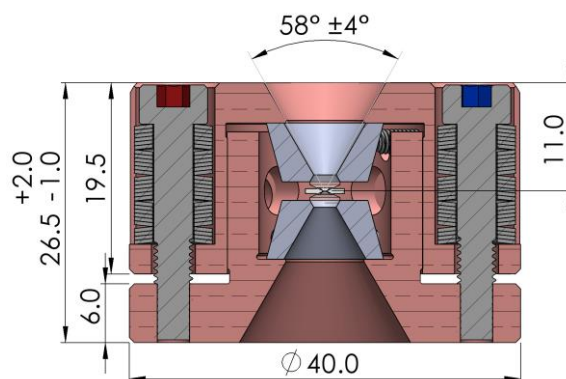
Material:	BeCu C17200 HT04
Height:	~30.7 (26.5) ± 1.5 mm
Diameter:	40.0 mm
Working distance:	~12.6 (11.0) ± 1 mm
Mass:	~ 250 (220) g
Optical opening:	Up to 60 degrees
Diamond seats:	Tungsten carbide (typ.), Optional BeCu, Pascalloy and cBN (Non-magnetic)
Pressure screws:	M4 x 25 (22) mm, 2x LH and 2x RH or 4x RH (model dependent)
Spring washers:	8.0 mm OD, 4.2 mm ID, 0.3-0.5 mm thick.
Diamond seat diameter:	12.5-13.0 mm (13.5 mm max)
Minimum height of two seats + two diamonds:	13.5 mm (13.0 mm)
Maximum experimental P:	>100 GPa

DAC Dimensions

Regular Version



Shortened Version

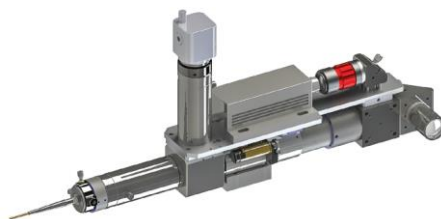


Related equipment

Laser drilling systems



Ruby pressure systems



Membrane P Control



For more information please visit www.DACTools.com



Nov. 2023

BeCu DAC with rocker seat and integrated membrane pressure control

Model BeCu-MC38R12

Initially this compact (38 mm OD, ~56 mm long) DAC was designed as nonmagnetic DAC for use with Janis ST-500 (or comparable, such as Physike Scryo-S500) cryostats and strong magnetic fields (superconducting magnets) for Raman and other spectroscopy measurements requiring short working distance ($WD \leq 12\text{mm}$).

The DAC was initially designed to have an integrated membrane pressure control (no-hole membrane). Nevertheless it can be loaded and operated independently of the membrane. The DAC can be closed and pressure can be controlled with 4x M4x0.7mm screws and a set of Belleville spring washers. For studies in magnetic field Inconel / Ti5 / BeCu screws and Inconel or bronze Belleville washers can be used.

The DAC can use different types of diamond seats depending on diamond type and experimental conditions, for example flat low or high seats (~3.2 / ~5.3 mm). The ability to adjust the diamond tilt with a rocker makes this DAC ideal for use with conical support Boehler-Almax type diamond anvils. The seats can be made either from tungsten carbide (magnetic) or BeCu / Ti5 / Inconel / Pascalloy / cBN (non-magnetic).

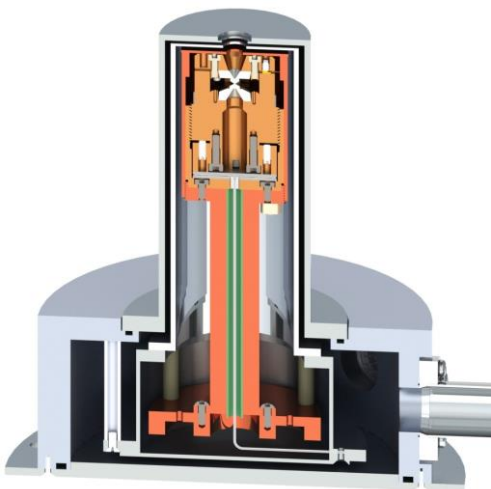
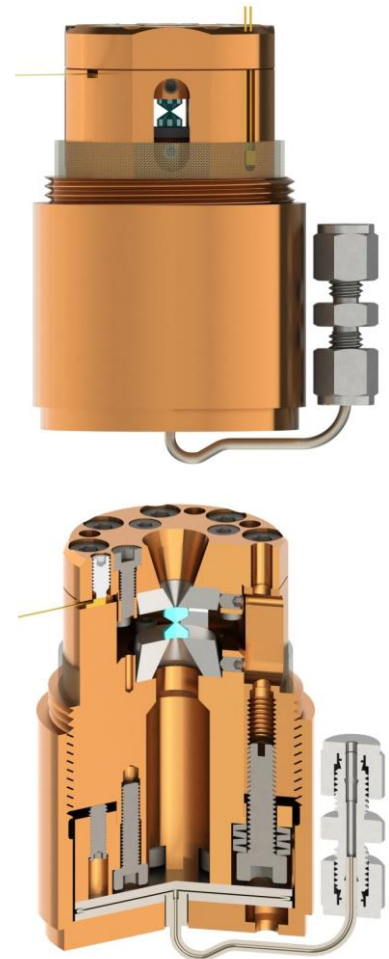
To prevent uncontrollable increase of pressure during lowering the temperature the DAC allows to transfer pressure from the screws to the membrane during / before the experiment. For that the DAC has access to the pressurizing screws from top, and the screws can be provided with either hexagonal sockets for Allen wrench (2-2.5 mm), or a slot for a screwdriver.

For even better and smoother pressure control several decompression springs can be engaged before screwing the DAC into the membrane can. For decompression springs either Belleville washers or a slotted tube spring can be used. The spring force can be adjusted by M3 set screws.

For accurate temperature measurements of the DAC there are two types of cut-outs for securing SD-type sensors (2 mm wide, 1 mm high): Two symmetric 2mm wide 1 mm deep cutouts go along the DAC body and two slots in the cylinder part normal to cylinder axis toward the piston. The sensor with Apiezon N grease can be inserted into the matching slot and secured with either G10/G11 (garolite) split ring or a nylon-tipped screws.

Both lower and upper diamond seats have adjustable lateral position. Also the sockets for diamond seats have threaded holes (M1.6) for service screws - to attach furnishings and accessories for mounting electric wires and gasket holders.

The split cylinder design (the cup with the rocker and diamond seat is detachable from the main cylinder) allows for relatively easy mounting of wires for electric measurements.





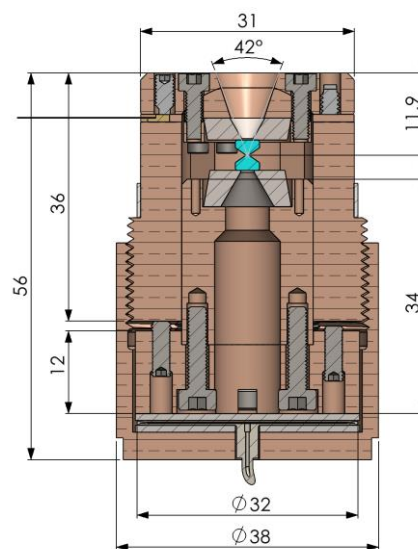
Specifications of BeCu DAC with rocker seat and integrated membrane pressure control

Main DAC Specifications

- Max. DAC diameter: 31 mm / 33 mm thread
- DAC length: ~49 mm
- Max. can diameter: 38 mm
- Overall length: <56 mm
- Optical WD: ~12 mm (~20 mm in cryostat)
- Membrane: Blind, 32 mm OD
- Max membrane force at 150 bar: 1,200 kgf
- Spring washers: Alloy steel / Inconel, BeCu (non-magnetic)
- Membrane material: SS 304/316 / Inconel (non-magnetic)
- Compression screws: M4x0.7 RH, M3x0.5 decompression sockets
- Decompression springs: Up to 5 mm OD, 8 mm long
- Sensor package: SD, e.g. DT-670-SD
- Maximum pressure: >100 GPa with 200 um diamond culets
>40 GPa with 300 um diamond culets

BeCu Material Properties

- Type: C17200 / Alloy 25
- Temper: HT04 (TH)
- Density: 8.25 g/cc
- Ultimate strength: 1380 MPa (typ)
- Yield strength (0.2%): 1240 MPa (typ)
- Hardness Rockwell C: 38-42 (typ)
- Thermal expansion (0°C): ~16.0 $\mu\text{m}/\text{m}\cdot^\circ\text{C}$
- Specific Heat Capacity: 0.420 J/g $\cdot^\circ\text{C}$
- Thermal conductivity (20°C): 105-130 W/m-K



Related equipment

Pressure controllers



Ruby pressure systems



DAC Accessories



For more information please visit www.DACTools.com

12.03.2022

Non-magnetic PPMS-type BeCu Diamond Anvil Cells (DAC)

Model DT-25/28-55-BeCu-DAC

The non-magnetic DT-25/28-55-BeCu DAC is designed for a variety of experiments at cryogenic conditions in confined spaces (28 mm min. diameter of the cryostat bore). The DAC is compatible with HMD 25 mm DAC (DAC-SRr-25-55) while has a lot of modifications to improve performance, stability, reliability, and ease of operations. With proper diamond anvil and seat selection the DAC can be routinely used to Megabar pressures.

All main parts of the DAC are made of non-magnetic Beryllium Copper C17200 alloy in full hard HT(TH04) temper. The DAC can be supplied in fully non-magnetic form if required. Non-magnetic screws, set screws, and diamond seats can be made either of the BeCu alloy or Ti5 (Ti-6AL-4V) alloy. We can also provide cBN seats. If magnetic properties are not critical – the DAC can be supplied with common alloy or stainless steel accessories / hardware and WC diamond seats.

The DAC has a rocker / spherical seat so that the tilt of one diamond anvil can be easily adjusted. The opposite / piston-side diamond anvil has lateral adjustments for diamond centering and proper positioning.

Unlike HMD DAC, the piston can be inserted into the DAC from the “back” eliminating the need to unscrew and remove the other diamond with the rocker assembly every time. This makes alignment and DAC loading significantly easier and faster. When the piston is moving along the axis – it does not rotate due to the piston rotation locking set screws (can use one or two).

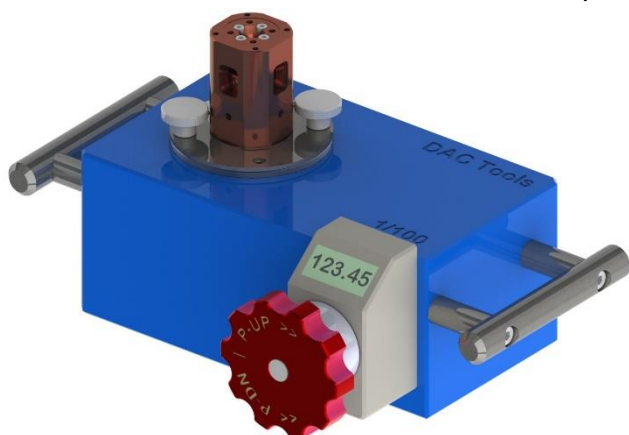
The pressure in the DAC is increased by rotating one pressurizing screw with integrated ceramic thrust ball bearings. The pressurizing screws has a pitch of 1 mm. The pressure in the DAC is typically increased with an optional 100X gearbox (which can provide piston / pressurizing screw advancement with 100 nm = 0.1 um resolution). Pressure in the DAC can be increased without the gearbox but with lower resolution unless the solid compression axis is replaced by spring washers. Alternatively the DAC can be integrated with a membrane pressure control system.

The pressure in the DAC can be increased in several modes:

1. Dry - when the screw is pushing the piston directly (normally required gearbox or membrane);
2. Semi-soft - when there is a delrin disk between the screw and the piston and this disk absorbs some of the load and allows more smooth pressure increase;

3. Spring mechanism – when there is a stack of Belleville spring washers or a single split tube spring which allows to increase DAC pressure in the DAC through spring action with controller force like in most of the room temperature DACs.

The DAC comes equipped with all relevant hardware (except diamond anvils) - Allen hex wrenches, keys for rotating the pressurizing screws and “front” anvil assembly, tools for handling (extracting and inserting) the piston, and spare parts (screws, set screws, diamond seats, parts of the bearing, etc.).





Specifications of DT-25/28-55-BeCu-DAC

Main DAC Specifications

Height: 55 mm

Diameter: 28 mm (25 mm square)

Working distance: ~10.0-10.5 mm

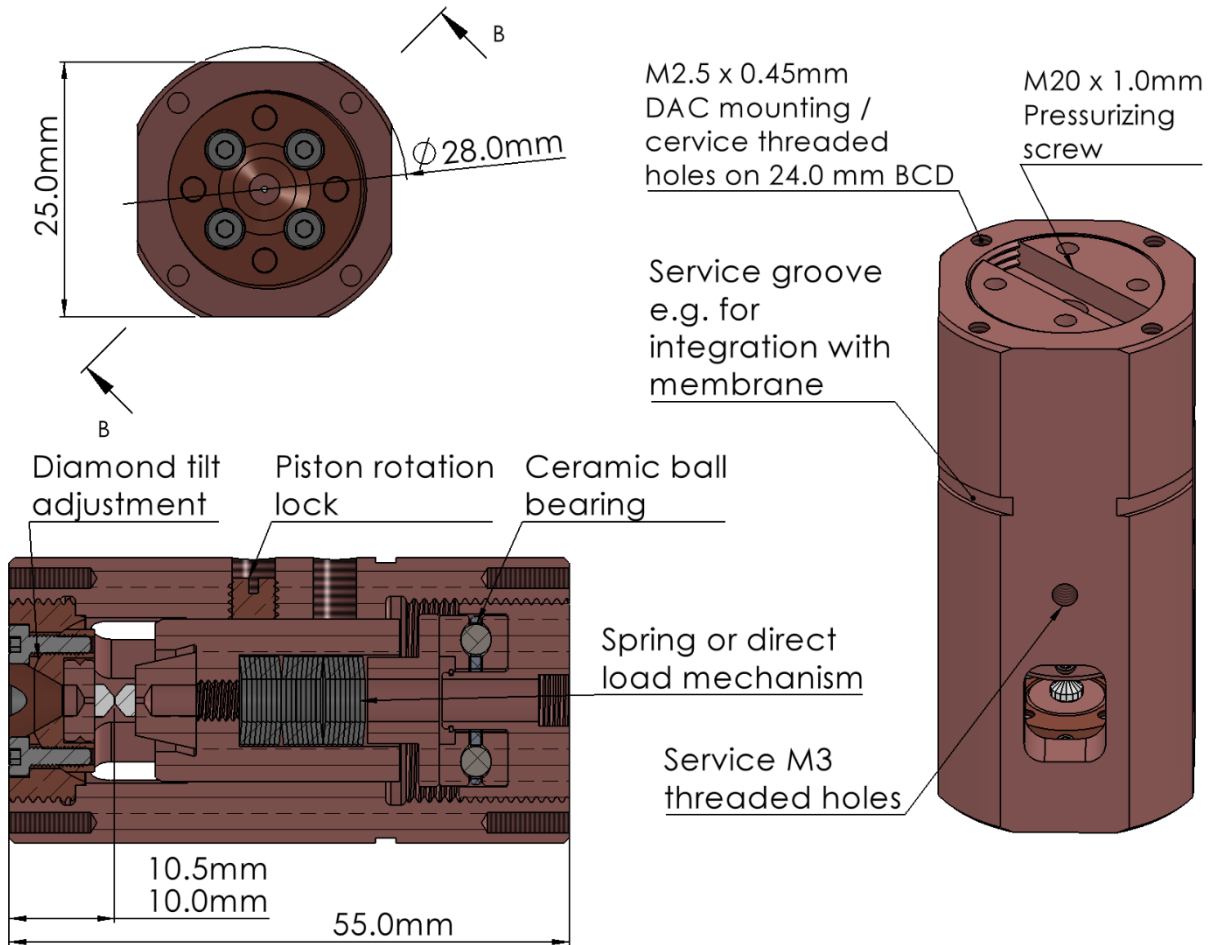
Mass: ~ 210 g

DAC material: BeCu C17200 in HT (TH04) temper

Seats: BeCu C17200; Opt. Ti5, WC, or cBN.

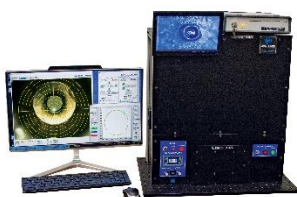
Screws: BeCu / Ti5; Opt. Alloy / St. steel

Maximum Pressure: >100 GPa

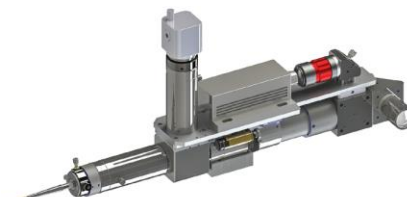


Related equipment

Laser drilling systems



Ruby pressure systems



Membrane P Control



For more information please visit <http://dactools.com/diamond-cells>



Dec. 2023

Gearbox for DT-25/28-55-BeCu Diamond Anvil Cells (DAC)

Model DT-GB-PPMS-DAC

The manual mechanical gearbox is used for controlling pressure in PPMS-type DACs which have one large screw for pressure control such as DACTools' DT-25/28-55-BeCu-DAC and PPMS Diamond Anvil Cells such as HMD DAC-SRr-25-55 and DAC-SPr-17.5-40.

The mechanical gearbox has 100:1 reduction ratio. One full turn of the handle corresponds to 1/100 of a turn (3.6 degrees) of the DAC turning mechanism. With 1 mm pitch pressurizing screw in the DAC one full turn of the handle corresponds to 10 μm pressurizing screw advancement.

The Gearbox is equipped with an electronic turn counter with 5 digit resolution. The counter is resettable and can be easily zeroed (by pressing buttons) before every experiment (if desired).

Typically the counter can be set with 2 decimal digits so that each smallest digit corresponds to rotation of 1/100 of a turn or 3.6 degrees on the controlling handle and 1/10,000 of the turn = 0.036 degrees on the DAC end. With 1 mm pitch of the pressurizing screw this corresponds to 100 nm (0.1 μm) pressurizing screw advancement.

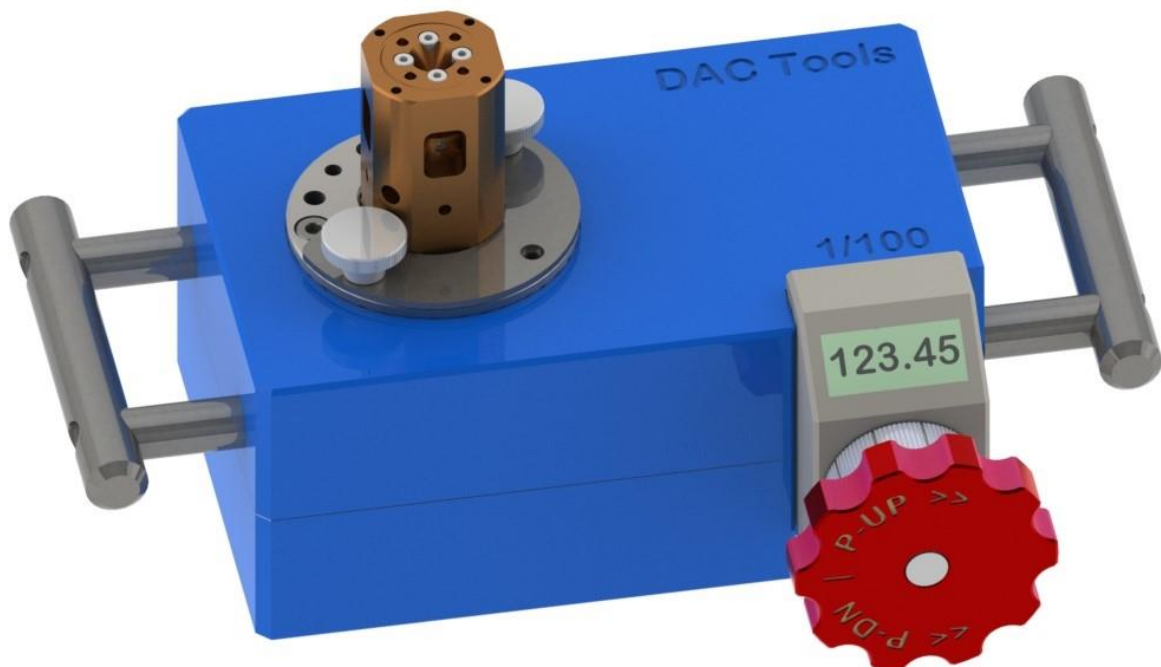
In addition to the digital turn counter the gearbox is equipped with a rotary scale with 100 divisions.

The gearbox is typically supplied with the adapter (DAC Holder and Output Die) for 25/28 mm DAC. These parts are interchangeable and additional adapters for smaller DACs of this type can be supplied on demand.

The body of the gearbox is made of high-strength aluminum alloy 7075-T6. All gears inside the gearbox are made of either steel or bronze. All other components are made of high-grade metal alloys. Therefore the construction of the gearbox is very sturdy and all motions are reliable and reproducible.

The gearbox has multiple M5 service holes for mounting on for example outside the cryostat or close to the ruby system.

The current version of the gearbox is manual but it can be easily motorized on demand and controlled remotely.





Specifications of the DT-GB-PPMS-DAC Gearbox

Main Gearbox Specifications

Length: 204 mm

Width: 127 mm (with counter)

Height: 61-75 mm (without DAC)

Mass: ~ 3 kg

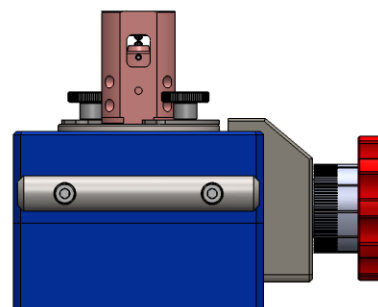
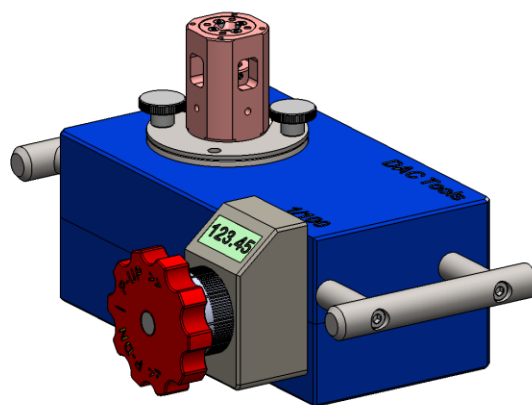
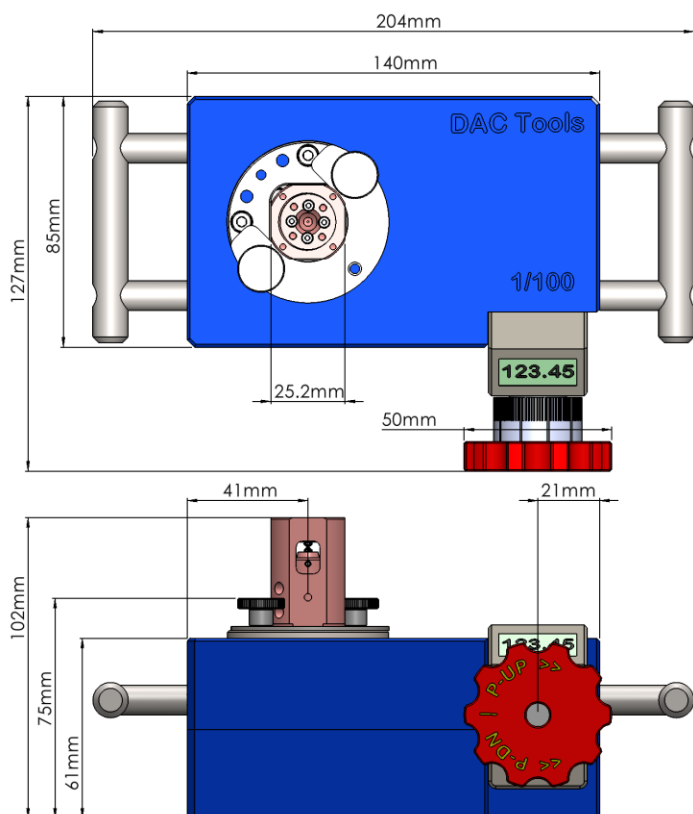
Max. DAC size: 28 mm OD / 25 mm square

Material: Body - Al 7075-T6 + Stainless Steel 304;
Inside – St. steel, hardened steel, bronze

Gear Ratio: 100:1

Counter: Electronic, resettable, 5 digits

Typical counter resolution: 3.6° = 1/100 turn
0.036° = 1/10,000 turn of the DAC side

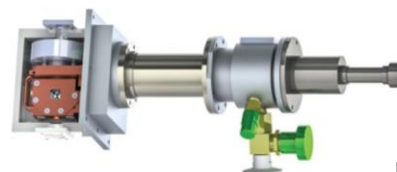
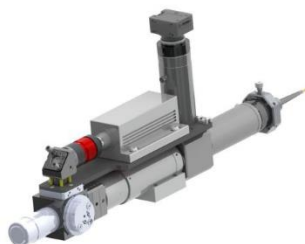


Related equipment

Diamond Cells

Ruby pressure systems

Cryostats for DACs



For more information please visit <http://dactools.com/diamond-cells>



11.28.2022