Multi-CF™ UHV Spherical Octagon Vacuum Chambers

FOR USE IN:

- Compact and miniature UHV vacuum chambers
- Cold physics experiments
- Portable low-cost UHV systems
- High-complexity UHV subsystems
- UHV vacuum manipulator systems
- UHV specimen transfer systems
- General UHV vacuum plumbing

FEATURES / OPTIONS:

- Easy access / High port accessibility
- Grabber Grooves on all sealing surfaces (except 1.33” CF ports)
- Multiple sealing surface configurations cut on a hollow sphere
- Unitary stainless steel 316L construction. Titanium custom also available
- No welds, no inside corners, highly polished
- Precise port alignment of <0.1 degree
- ConFlat™ CF port diameters: 10”, 8”, 6”, 4.5”, 2.75”, 1.33”.

A few examples of Spherical Octagon UHV Vacuum Chambers

Introduction

Kimball Physics UHV (ultra-high vacuum) Spherical Octagon Vacuum Chambers are multi-port fittings that utilize Conflat™ (CF) sealing surfaces at each port. We refer to them as MCF or Multi-CF™ vacuum chambers or instrument housings and they are available in a series of sizes that are also compatible with other vacuum fittings in the industry. They are precision CNC fabricated from monolithic specimens of 316L stainless steel. Custom fabricated titanium chambers are also an option.

There overall shape of the chamber is conceptually based on a hollow spherical geometry, with the outer surface, excluding the ports, convex and the inner surface concave.

For the majority of spherical octagon designs, two main or primary, large, symmetrically placed concentric and parallel port sealing surfaces intersect the sphere, with the largest port dimension defining the overall size of the chamber. For example, an 8” inch spherical octagon chamber has two 8” inch CF sealing surface ports.

There is then a secondary series of eight (8) CF sealing ports, typically perpendicular to the plane of the larger primary ports and that are evenly spaced circumferentially to define the *octagonal* planer geometry.

Generally, the fundamental design of spherical octagon vacuum chamber typically includes a total of 10 ports. Of course, there are exceptions with several other design variations, and where space is available, additional smaller ports have been added.

Description of Features and Options

The Multi-CF™ chambers are typically fabricated from a monolithic or unitary section of 316L stainless steel. Custom chambers of similar configurations can also be fabricated from various grades of titanium. Titanium minimizes stray magnetic fields and minimizes outgassing of hydrogen when pumping to extreme vacuum levels. With titanium about half the density of stainless steel and with similar structural properties, the systems are significantly reduced in weight.

These monolithic chamber structures, typically with no welds and no interior corners, are fabricated from a single piece of metallic stock using advanced CNC technology. This fabrication approach allows for the efficient use of material volume and structure in these configurations when compared to other structures in the industry that are comprised of multiple pieces that have been welded together. A high level of precision is possible with these manufacturing techniques, with port alignment typically within 0.1 degrees.

The multiport ConFlat™ flange (CF) sealing surfaces are machined directly into the global structure. This sealing surface technology utilizes a knife-edge geometry that engages an interposed malleable copper gasket allowing stable and structural connections between the flanges of various components. Predictable seals for ultra-high vacuums (UHV) that accompany very low pressure (< 10^{-11} torr) applications and that include temperature variations from bakeout procedures are possible. The port inside diameter (bore diameter) has been slightly enlarged to allow better access to the chambers internal volume and to also increase conductance, allowing more efficient vacuum pumping. We use modified copper gaskets, with their inner diameters also slightly increased. These improved port features are still fully compatible with standard CF sealing surfaces while maintaining their structural and sealing integrity.

Other features of our vacuum chambers that enable UHV applications include minimally contoured, highly polished mirror-like surfaces, typically with minimal or no welds or inside corners to provide an optimum useable internal volume. Our distinctive appearance is well-known throughout the industry and attests to the highest levels of precision, quality and function.

A circumferential array of double density threaded holes are typically associated with each ConFlat™ sealing surface port when size allows. Imperial threads are standard, metric threads are available as an option. This provides redundancy if there is a problem with a bolt, and allows chambers to be mounted in similar orientations when directly attached to each other using Kimball Physics close coupling flanges. Please visit our website to learn how the close coupler allows efficient connection of our vacuum fittings into close proximity. Twelve (12) point silver plated machine screws are typically used (imperial threads) and allow small wrench sizes to torque the bolts, with the low friction

CF Port Outside Diameter (CF Sealing Surface)	Kimball Physics Port Code	Bolts per Sealing Surface	Bolt Size	Grabber Grooves
1.33”	A	12	#8-32	No
2.75”	C	12	1/4-28	Yes
4.5”	E	8	5/16-24	Yes
6.0”	F	24 or 32	5/16-24	Yes
8.0”	G	40	5/16-24	Yes
10.0”	H	40	5/16-24	Yes

silver surface minimizing the chance of the bolt inappropriately binding or breaking.

Internal circumferential channels that we refer to as “Grabber Grooves”, are typically present at each port greater or equal than 2.75” inches in diameter. The Grabber Grooves are used to precisely and securely attach various devices and instruments inside the chamber using our Grove Grabber connectors. In addition, we have a complete line of “eV parts”, often referred to as a virtual “erector set” for scientists to create their own custom prototype devices. These parts also allow users to interface with their own hardware and devices to securely mount them to the inside of the chambers. These eV parts save time and money by bypassing the need to design and custom machine these parts. Please refer to our website (eV parts kit) for a more in-depth discussion of the scope and capabilities of this product.

External mounting features are present on many of the designs that allowing the chamber to mounted to an optical bench or apparatus. These features can include externally placed surfaces and grooves adjacent to the sealing surfaces or as mounting holes available in the surface geometry. The bolt configurations of the ports themselves, using Kimball Physics flange adapters, can also serve as mounting or attachment points to other fittings and apparatus with Conflat™ surfaces.

In the next section we explore the more specific details about the available vacuum chamber configurations, dimensions, and variations that are available. Please reach out to Kimball Physics to engage our specialists if you need more details or require a custom system for your specific application.

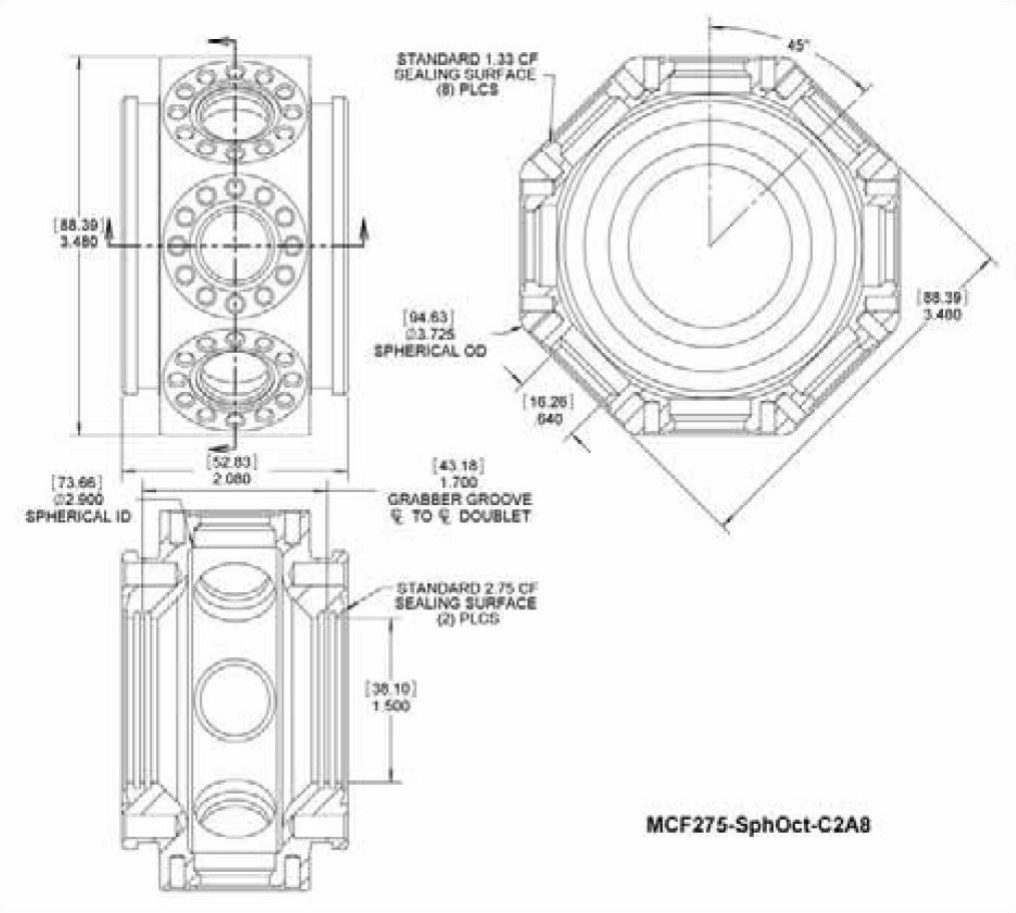
2.75” Multi-CF™ Spherical Octagons

MCF275-SphOct-C2A8

The Kimball Physics **MCF275-SphOct-C2A8** is a 2.75” Spherical Octagon miniature UHV chamber that has two (2) 2.75” CF primary or main ports and eight (8) 1.33” CF secondary ports. The 2.75” ports have external integrated grooves that accept our Kimball Physics external mounting brackets. Internal Grabber Grooves are present within the 2.75“ ports (no Grabber Grooves are available in the 1.33” ports) for stable internal mounting of fixtures, devices and apparatus. Groove Grabber clamps are available from Kimball Physics.

2.75” Spherical Octagon
MCF275-SphOct-C2A8

	MCF275-SphOct-C2A8
Multi-CF™ Fitting	Spherical Octagon
COMMON APPLICATION	Miniature UHV Vacuum Chamber
CONSTRUCTION / MATERIAL	Unitary Stainless Steel 316L (Titanium available as option)
1.33”CF SEALING SURFACES	Eight CF ports with (12) 8-32 tapped bolt holes per sealing surface. No Grabber Grooves available.
2.75” CF SEALING SURFACES	Two CF Sealing Surfaces with (12) 1/4-28 tapped bolt holes, plus one pair of Grabber Grooves (internal annular grooves) per sealing surface
EXTERNAL MOUNTING	Two 2.75” ports have built in OD grooves which accept Kimball Physics external mounting brackets. See External Mounting in Multi-CF hardware section of website.
PUMPING VOLUME	Internal Volume: 9.3 in^3 Spherical ID: 2.900 in



4.5” Multi-CF™ Spherical Octagons

MCF450-SphOct-E2A8, MCF450-SphOct-Ec2A8

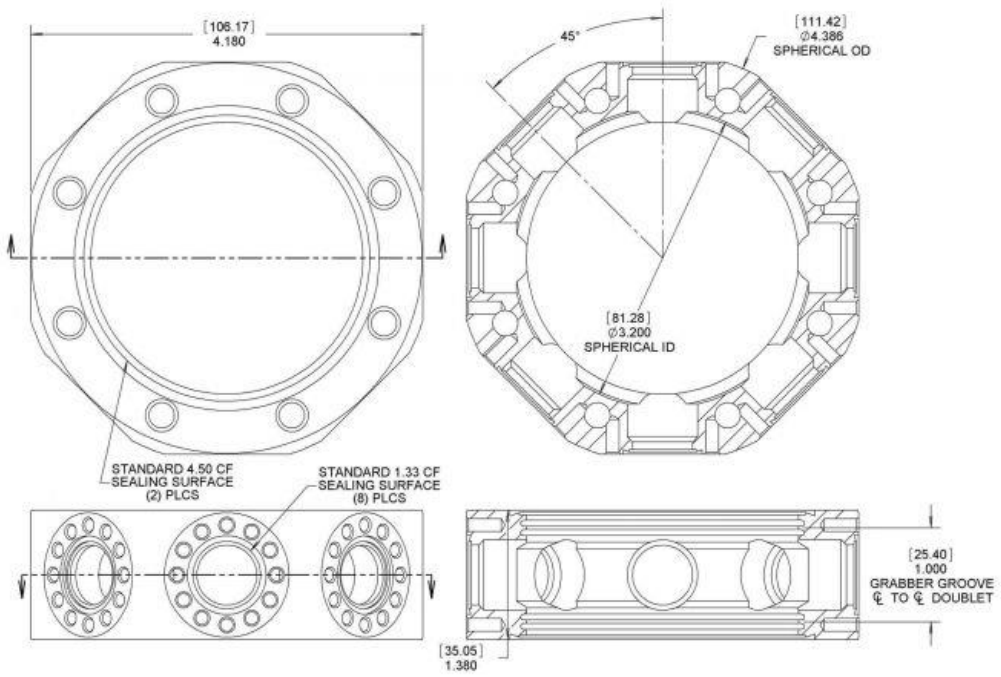
The Kimball Physics **MCF450-SphOct-Ec2A8** and **MCF450-SphOct-E2A8** are 4.5” Spherical Octagon UHV chambers that have two main or primary 4.5” (E) CF sealing surface ports and eight 1.33” (A) CF sealing secondary ports with uniform octagonal spacing.

The bolt holes for the main ports are available either as either clear or threaded. The clear holes (Ec) for the 4.5” ports allow lag style machine screws with washers and nuts to attach and secure with other structures.

The 4.5” port threaded (E) holes (standard Imperial thread 5/16”-24) should be used with silver coated bolts to reduce friction. Anticipated bolt length to connect the matting flange to the MCF chamber should be carefully determined to minimize chance of bottoming when tightening the bolt.

4.5” Spherical Octagon
MCF450-SphOct-E2A8

	MCF450-SphOct-E2A8 / Ec2A8
Multi-CF™ Fitting	Spherical Octagon
COMMON APPLICATION	UHV Vacuum Chamber
CONSTRUCTION / MATERIAL	Unitary Stainless Steel 316L (Titanium available as option)
1.33”CF SEALING SURFACES	Eight CF ports with (12) 8-32 tapped bolt holes per sealing surface. No Grabber Grooves available.
4.5” CF SEALING SURFACES	Two CF ports with (8) 5/16-24 tapped (or clear) bolt holes, plus one pair of Grabber Grooves per sealing surface
EXTERNAL MOUNTING	None
PUMPING VOLUME	Internal Volume: 12.0 in^3 Spherical ID: 3.200 in



MCF450-SphOct-E2A8

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6.0” Multi-CF™ Spherical Octagons

MCF600-SphOct-F2C8, MCF600-DblSphOct-F2C16, MCF600-SphOct-F2E1C7

The Kimball Physics **MCF600-SphOct-F2C8** 6.0” Spherical Octagon UHV chamber has two (2) 6.0” CF primary or main sealing surfaces (F) and eight (8) 2.75” CF secondary sealing surfaces(C). External mounting threaded holes are present on the main faces just outside the 6.00” CF sealing surface double density threaded hole circumferential bolt array.

The 6.00” main face can be mounted with external side mounting brackets (**MCF-600-ExtBrkt-SM**) that mate with standard optical table hardware. Internal grabber grooves are present on the 6.0” and the 2.75” ports for stable internal mounting of fixtures, devices and apparatus.

6.00” Spherical Octagon
MCF600-SphOct-F2C8

	MCF600-SphOct-F2C8
Multi-CF™ Fitting	Spherical Octagon
COMMON APPLICATION	UHV Vacuum Chamber
CONSTRUCTION / MATERIAL	Unitary Stainless Steel 316L (Titanium available as option)
2.75” CF SEALING SURFACES	Eight CF Sealing Surfaces with (12) 1/4-28 tapped bolt holes, plus one pair of Grabber Grooves (internal annular grooves) per sealing surface
6.0” CF SEALING SURFACES	Two CF Sealing Surfaces with (32) 5/16-24 tapped bolt holes, plus one pair of Grabber Grooves (internal annular grooves) per sealing surface
EXTERNAL MOUNTING	Yes. External mounting capability on 6” in flange face with Kimball Physics part MCF600-ExtBrkt.SM
PUMPING VOLUME	Internal Volume: 77.1 in^3 Spherical ID: 4.800 in

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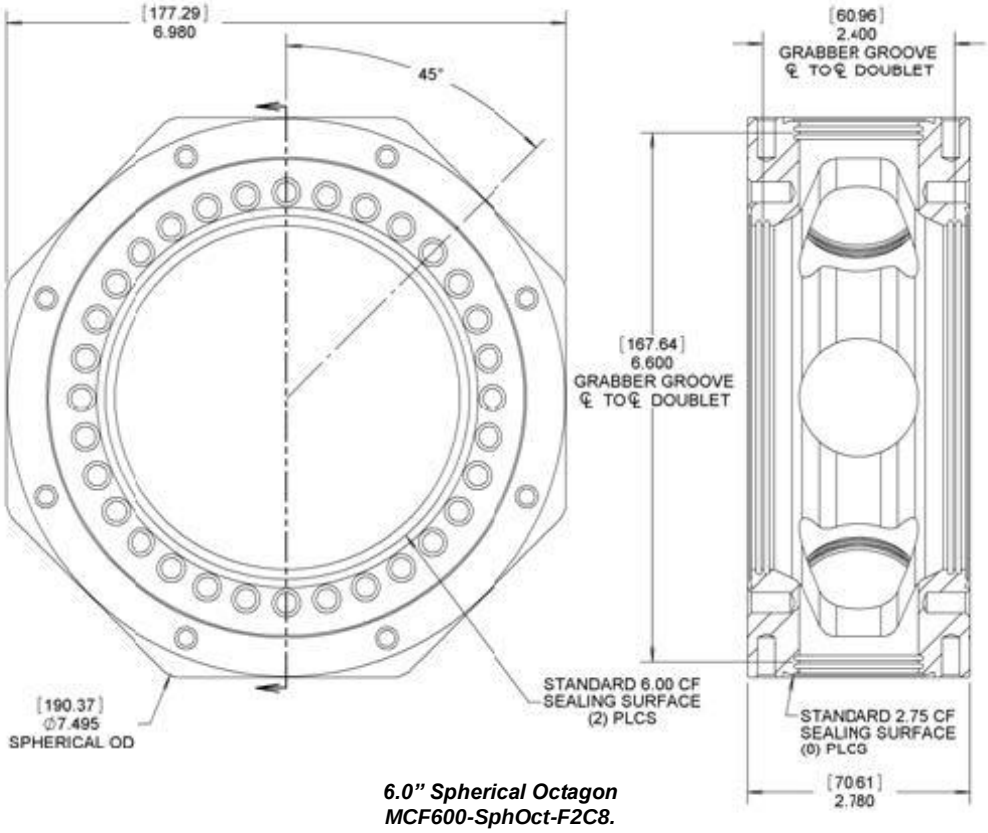
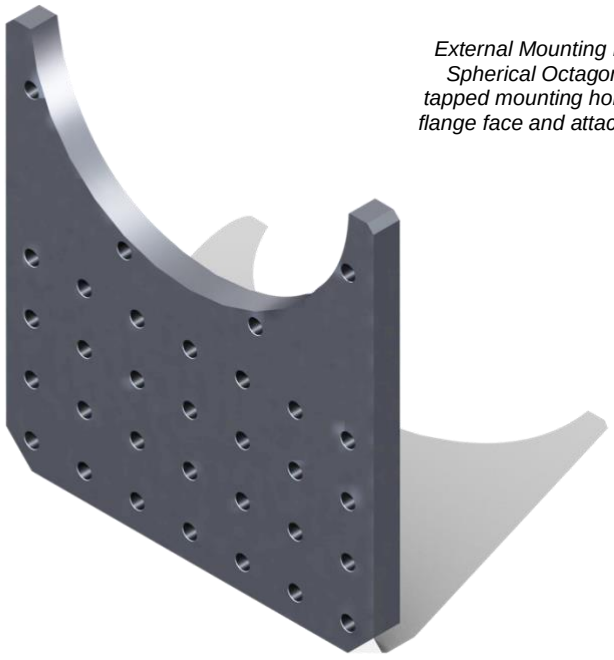


6.0" Spherical Octagon
MCF600-SphOct-F2C8.



External Mounting Bracket ***MCF600-ExtBrkt-SM*** *for 6.0" Spherical Octagon MCF600-SphOct-F2C8. Mates via tapped mounting holes on the outer perimeter of 6.00" inch flange face and attaches to standard optical table hardware.*

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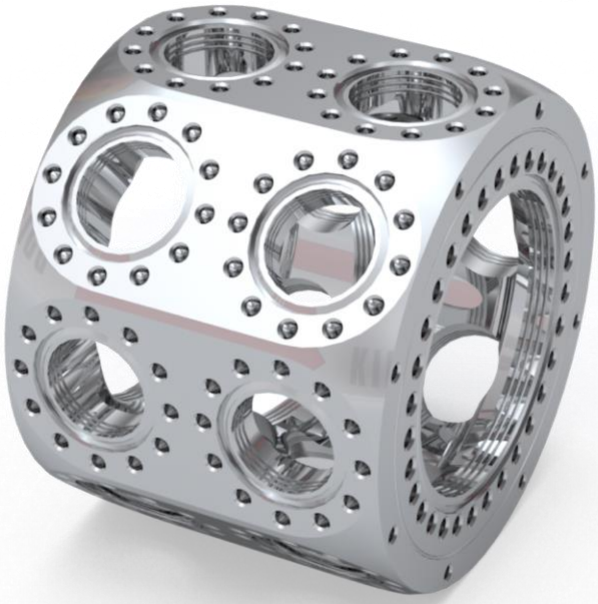
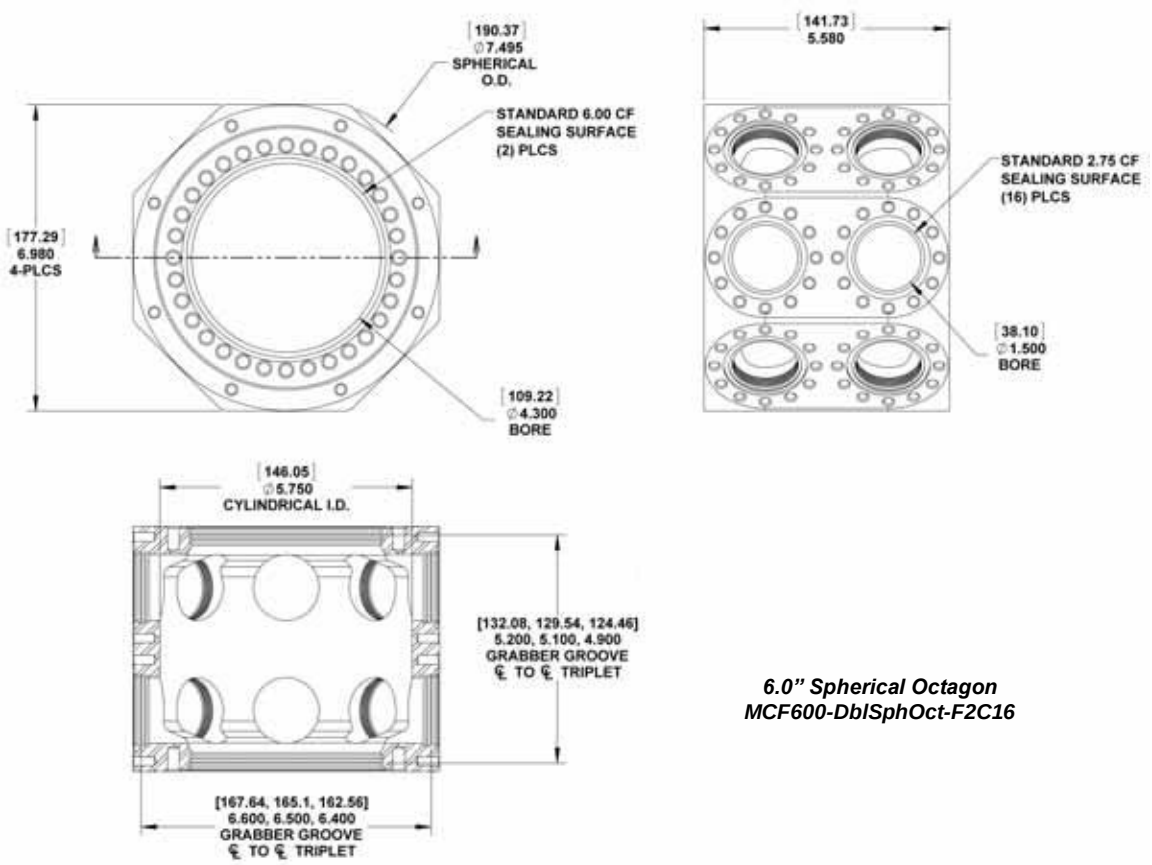
The Kimball Physics **MCF600-DblSphOct-F2C16** Double 6.0” Spherical Octagon UHV chamber is essentially two of our 6.0” spherical octagons fused together. The system includes two (2) 6.0” (F) primary or main ports and sixteen (16) 2.75” (C) secondary ports. External mounting holes are also present the perimeter of the main 6.00” face just outside the sealing surface bolt array and interface Kimball Physics external mounting brackets (**MCF-600-ExtBrkt-SM**). Internal Grabber Grooves are present on all the ports for stable internal mounting of fixtures, devices and apparatus.



6.0” Spherical Octagon
MCF600-DblSphOct-F2C16

	MCF600-DblSphOct-F2C16
Multi-CF™ Fitting	Spherical Octagon- Double
COMMON APPLICATION	UHV Vacuum Chamber
CONSTRUCTION / MATERIAL	Unitary Stainless Steel 316L (Titanium available as option)
2.75” CF SEALING SURFACES	Sixteen CF Sealing Surfaces with (12) 1/4-28 tapped bolt holes, plus one triplet of Grabber Grooves (internal annular grooves) per sealing surface
6.0” CF SEALING SURFACES	Two CF Sealing Surfaces with (32) 5/16-24 tapped bolt holes, plus one triplet of Grabber Grooves (internal annular grooves) per sealing surface
EXTERNAL MOUNTING	Yes. External mounting capability on 6” in flange face with Kimball Physics part MCF600-ExtBrkt.SM
PUMPING VOLUME	Internal Volume: 144 in^3 Cylindrical ID: 5.75 in



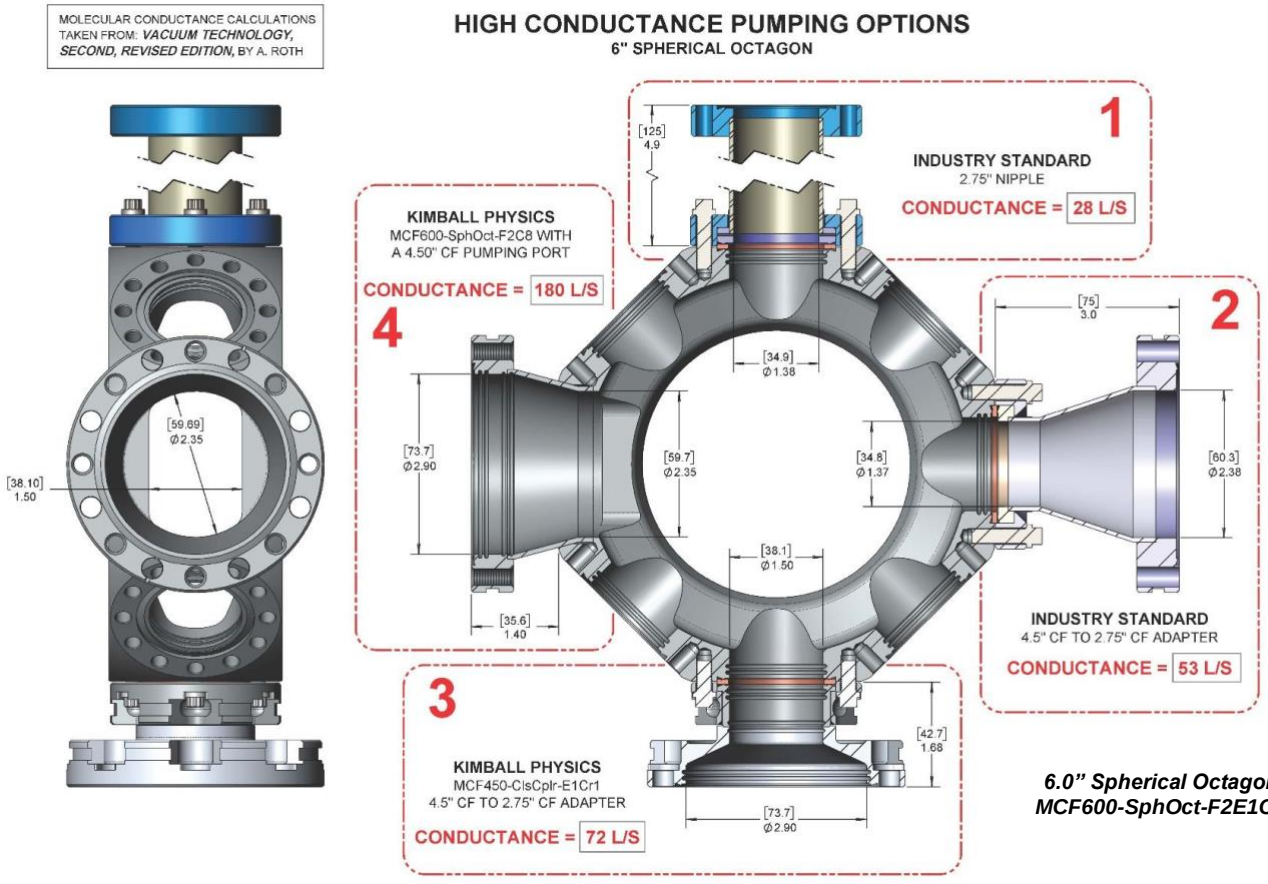
6.0" Spherical Octagon
MCF600-DblSphOct-F2C16

The Kimball Physics **MCF600-SphOct-F2E1C7** 6.0" spherical octagon UHV chamber with Pumping Port has two (2) 6.0"" CF primary or main ports, seven (7) 2.75" CF secondary ports and one (1) 4.5" CF pumping port and mount. The welded, non-rotatable pumping port with external bracket mounting groove is present for turbo pump connection and support.

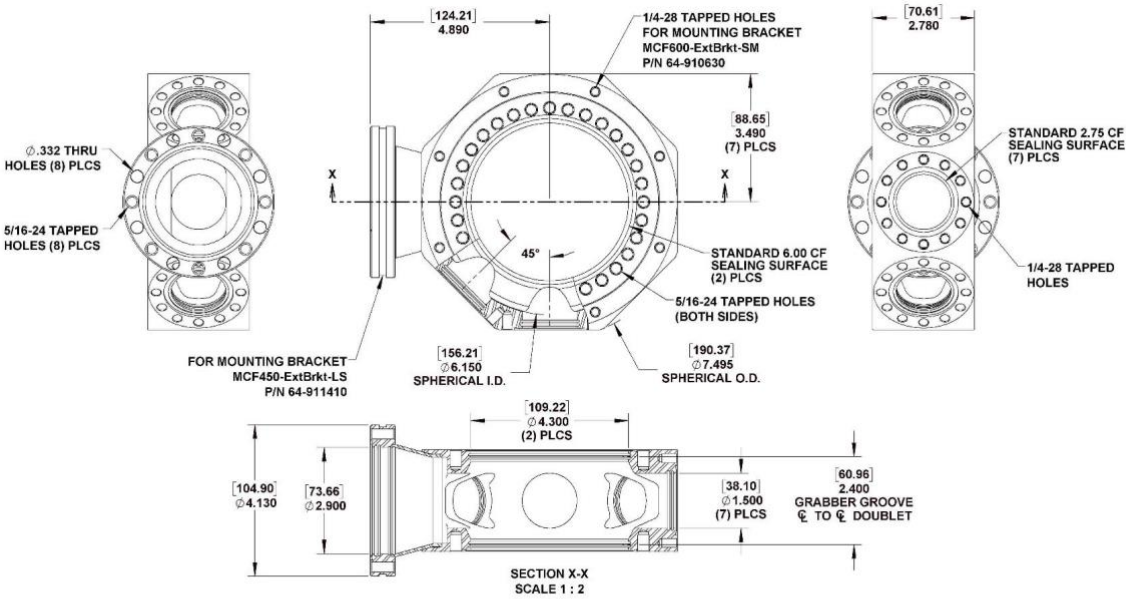
The increased bore diameter of the pumping port significantly increases conductance and pumping efficiency (please see figure below). The 6.00" ports also have threaded external mounting holes along the outer perimeter that interface with external mounting brackets. Internal Grabber Grooves are present on all the ports for stable internal mounting of fixtures, devices and apparatus.

6.0" Spherical Octagon
MCF600-SphOct-F2E1C7

	MCF600-SphOct-F2E1C7
Multi-CF™ Fitting	Spherical Octagon
COMMON APPLICATION	UHV Vacuum Chamber Efficient Pumping
CONSTRUCTION / MATERIAL	Unitary Stainless Steel 316L (Titanium available as option)
2.75" CF SEALING SURFACES	Seven CF Sealing Surfaces each with (12) 1/4-28 tapped bolt holes, plus one triplet of Grabber Grooves (internal annular grooves) per sealing surface
4.5" CF SEALING SURFACES	One CF Sealing Surface Pump Mount. Welded non-rotatable pumping port with external bracket mounting groove for turbo pump support. Alternating (8) clear (0.332") and (8) tapped flange holes (5/16-24) Grabber Grooves for internal mounting
6.0" CF SEALING SURFACES	Two CF Sealing Surfaces each with (32) 5/16-24 tapped bolt holes, plus one triplet of Grabber Grooves (internal annular grooves) per sealing surface
EXTERNAL MOUNTING	Yes, with (8) bolt holes on the 6" in flange face. Mates with side mounted external bracket: MCG600-ExtBrkt-SM
PUMPING VOLUME	Internal Volume: 76.8 in^3 (1258.5 cc) Spherical ID: 6.150" in (156.21 mm) Spherical OD: 7.495" in (190.37 mm)



6.0" Spherical Octagon
MCF600-SphOct-F2E1C7



MCF600-SphOct-F2E1C7

QUICK OVERVIEW

UHV VACUUM CHAMBER WITH IMPROVED CONDUCTANCE TURBO PUMPING PORT
(2) 6.00" CF, (1) 4 1/2" CF & (7) 2.75" CF
GRABBER GROOVES FOR INTERNAL MOUNTS ON 6.00", 4 1/2" & 2.75" CF PORTS
SPHERICAL ID: 6.150" (156.21 mm)
SPHERICAL OD: 7.495" (190.37 mm)
INTERNAL VOLUME: 76.9 in. (1258.5 cc)
WEIGHT: 11.56 lbs (5.24 kg)
KPI P/N: 53-181230

6.0" Spherical Octagon
MCF600-SphOct-F2E1C7

8.0" Multi-CF™ Spherical Octagons

MCF800-SphOct-G2C8, MCF800-ExtOct-G2C8, MCF800-ExtOct-G2C8A16

The Kimball Physics **MCF800-SphOct-G2C8** 8.0" Spherical Octagon UHV chamber has two (2) 8.0" CF primary or main ports and eight (8) 2.75" CF secondary ports. Grabber Grooves are present on all the ports for stable internal mounting of fixtures, devices and apparatus.

	MCF800-SphOct-G2C8
Multi-CF™ Fitting	Spherical Octagon
COMMON APPLICATION	UHV Vacuum Chamber
CONSTRUCTION / MATERIAL	Unitary Stainless Steel 316L (Titanium available as option)
2.75" CF SEALING SURFACES	Eight CF Sealing Surfaces with (12) 1/4-28 tapped bolt holes, plus one triplet of Grabber Grooves (internal annular grooves) per sealing surface
8.0" CF SEALING SURFACES	Two CF Sealing Surfaces with (40) 5/16-24 tapped bolt holes, plus one pair of Grabber Grooves (internal annular grooves) per sealing surface
EXTERNAL MOUNTING	No external mounting holes. Use Flange Adapter.
PUMPING VOLUME	Internal Volume: 106.6 in^3 Spherical ID: 6.65 in

8.0" Spherical Octagon
MCF800-SphOct-G2C8

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The Kimball Physics **MCF800-ExtOct-G2C8** 8.0" Extended Spherical Octagon UHV chamber has two (2) 8.0" CF primary or main ports and eight (8) 2.75" CF secondary ports. The distance between the parallel 8.0" ports has been extended to increase the depth and internal volume of the vacuum chamber. Internal Grabber Grooves are present on all the ports for stable internal mounting of fixtures, devices and apparatus.

	MCF800-ExpOct-G2C8
Multi-CF™ Fitting	Spherical Octagon
COMMON APPLICATION	UHV Vacuum Chamber
CONSTRUCTION / MATERIAL	Unitary Stainless Steel 316L (Titanium available as option)
2.75" CF SEALING SURFACES	Eight CF Sealing Surfaces with (12) 1/4-28 tapped bolt holes, plus one triplet of Grabber Grooves (internal annular grooves) per sealing surface
8.0" CF SEALING SURFACES	Two CF Sealing Surfaces with (40) 5/16-24 tapped bolt holes, plus one pair of Grabber Grooves (internal annular grooves) per sealing surface
EXTERNAL MOUNTING	No external mounting holes. Use Flange Adapter.
PUMPING VOLUME	Internal Volume: 160.9 in3 (2,637 cc) Spherical ID: 7.10 in (180.34 mm)

8.0" Spherical Octagon (Extended) MCF800-ExtOct-G2C8

The Kimball Physics **MCF800-ExtOct-G2C8A16** 8.0" extended spherical octagon UHV chamber has two (2) 8.0" CF primary or main ports, eight (8) 2.75" CF secondary ports and an additional sixteen (16) 1.33"CF ports. The distance between the main parallel 8.0" ports has been increased to enlarge the depth and internal volume of the vacuum chamber. Internal Grabber Grooves are present on 8.0" and 2.75 " ports for stable internal mounting of fixtures, devices and apparatus. No grooves are present on the 1.33" ports.

8.0" Spherical Octagon (Extended) MCF600-ExtOct-G2C8A16

	MCF800-ExpOct-G2C8A16
Multi-CF™ Fitting	Spherical Octagon
COMMON APPLICATION	UHV Vacuum Chamber
CONSTRUCTION / MATERIAL	Unitary Stainless Steel 316L (Titanium available as option)
1.33” CF SEALING SURFACES	Sixteen CF Sealing Surfaces each with (12) 8-32 threaded bolt holes. No Grabber Grooves are present on 1.33” ports.
2.75” CF SEALING SURFACES	Eight CF Sealing Surfaces each with (12) 1/4-28 tapped bolt holes, plus one triplet of Grabber Grooves (internal annular grooves) per sealing surface
8.0” CF SEALING SURFACES	Two CF Sealing Surfaces each with (40) 5/16-24 tapped bolt holes, plus one pair of Grabber Grooves (internal annular grooves) per sealing surface
EXTERNAL MOUNTING	No external mounting holes. Use Flange Adapter.
PUMPING VOLUME	Internal Volume: 106.6 in^3 Spherical ID: 6.65 in

10.0” Multi-CF™ Spherical Octagons

MCF1000-SphOct-H2C8,

The Kimball Physics **MCF1000-SphOct-H2C8** 10.0” spherical octagon UHV chamber has two (2) 10.0” CF primary or main ports and eight (8) 2.75” CF secondary ports. Internal grabber grooves are present on all the ports for stable internal mounting of fixtures, devices and apparatus.

	MCF1000-SphOct-H2C8
Multi-CF™ Fitting	Spherical Octagon
COMMON APPLICATION	UHV Vacuum Chamber
CONSTRUCTION / MATERIAL	Unitary Stainless Steel 316L (Titanium available as option)
2.75” CF SEALING SURFACES	Eight CF Sealing Surfaces with (12) 1/4-28 tapped bolt holes, plus one triplet of Grabber Grooves (internal annular grooves) per sealing surface
10.0” CF SEALING SURFACES	Two CF Sealing Surfaces with (40) 5/16-24 tapped bolt holes, plus one triplet of Grabber Grooves (internal annular grooves) per sealing surface
EXTERNAL MOUNTING	No external mounting holes. Use Flange Adapter
PUMPING VOLUME	Internal Volume: 202.3 in^3 Spherical ID: 8.90 in

10.0” Spherical Octagon
MCF1000-ExtOct-H2C8A16

Category	Product Description	Model	Other Features	Port Code, Dimension (inches) and Number of Ports					
Spherical Octagon				**A 1.33"**	**C 2.75"**	**E 4.5"**	**F 6.0"**	**G 8.0"**	**H 10.0”**
	2.75" Spherical Octagon	MCF275-SphOct-C2A8	Ext Mnt Cap	8	2				
	4.5" Spherical Octagon (Clear Holes)	MCF-450_SphOct-Ec2A8	Clear Holes	8		2			
	4.5" Spherical Octagon (Tapped Holes)	MCF-450_SphOct-E2A8	Tap Holes	8		2			
	6.0" Spherical Octagon	MCF-600-SphOct-F2C8			8		2		
	6.0" Double Spherical Octagon	MCF600-DblSphOct-F2C16	Double		16		2		
	6.0" Spherical Octagon Pumping Port	MCF-600-SphOct-F2E1C7	Pumping Port		7	1	2		
	8.0" Spherical Octagon	MCF800-SphOct-G2C8			8			2	
	8.0" Extended Spherical Octagon	MCF800-ExtOct-G2C8	Extended		8			2	
	8.0" Extended Spherical Octagon	MCF800-ExtOct-G2C816	Extended	16	8			2	
	10.0" Spherical Octagon	MCF1000-SphOct-H2C8			8				2
Notes	Background Image: MCF600-SphOct-F2C8								

References

For more information about Multi-Port CF (MCF) Vacuum Chambers and Accessories, visit our website at: Multi-CF Hardware (MCF™ Hardware and Accessories)

Other References:
MCF Vacuum Chambers Overview (Vacuum Chambers and Accessories)
Spherical Octagon- Multi-CF Hardware
Spherical Cube- Multi-CF Hardware
Spherical Cube Expanded- Multi-CF Hardware
Spherical Hexagon- Multi-CF Hardware
Thin Flange- Multi-CF Hardware
Close Coupler (non-rotatable)- Multi-CF Hardware

Notes:
1. Cautions:
   -Silver Plated Bolts or Equivalent Lubrication must be used.
   -Please measure the hole depth and other flange / copper ring /part thicknesses
   -Choose a correct bolt length such that the bolt doesn’t bottom in the tapped hole prior to tightening the structure.
2. 3D Solid Models of all parts shown are available as STEP files.
   They can be downloaded from Kimball Physics Website for interactive visualization and measurements in your CAD software environment.
3. Specifications Subject to Change Without Notice.
4. Images are not to scale
5. DE Altobelli, DT Taylor 2/22/2023

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